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SCIENCE

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In This Issue

Pages 547—574

Hybrid Seed Corn

George Harrison Shull

Thomas Hunt Morgan

Clarence Erwin McClung

Statement Concerning S. 1850

Committee Supporting the Bush Report

Technical Papers

In the Laboratory

News and Notes

Book Reviews

Letters to the Editor

Obituary

Science Legislation

Complete Table of Contents Page 2

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VOL. 103 FRIDAY, MAY 3, 1946 No. 2679

Contents

Hybrid Seed Corn: *George Harrison Shull* 547

OBITUARY

Thomas Hunt Morgan: *H. J. Muller* 550

Clarence Erwin McClung: *D. H. Wenrich* 551

TECHNICAL PAPERS

Occurrence of Mitotic Crossing-over Without Meiotic Crossing-over: *Germaine LeClerc* 553

Linkage and Crossing-over Between Black Pigmentation and Susceptibility to Induced Fibrosarcoma in Mice: *Leonell C. Strong* 554

Haploidy as a Factor in the Polymorphic Differentiation of the Hymenoptera: *Stanley E. Flanders* 555

Carcinogenic Substances From Pituitary Glands of Cattle: *Henry K. Wachtel* 556

SCIENCE LEGISLATION

Statement Concerning S. 1850: *Committee Supporting the Bush Report* 558

NEWS AND NOTES 559

IN THE LABORATORY

Nucleosis of Skeletal Muscle: Its Value as a Biological Test: *Rudolf Altschul* 566

On the Fluorometric Determination of Nicotinamide: *John V. Scudi* 567

Chloride-free Filter Paper: *Daniel Cushing, Ralph N. Prince,* and *Joseph Seiberlich* 568

LETTERS TO THE EDITOR

Science and Mankind's Plight: *G. Edgar Owen* 569

The Atomic Bomb and the Anthropologists: *M. F. Ashley Montagu* 570

Pathogenesis of Kernicterus: *Alexander S. Wiener* and *Matthew Brody* 570

Genetics and Biological Theory: *Alan Deakin* 570

Are Scientists Irresponsibles?: *L. A. Hawkins* 572

BOOK REVIEWS

Chemical crystallography: an introduction to optical and X-ray methods: C. W. Bunn. Reviewed by *Joseph S. Lukesh* 573

Principles of dynamic psychiatry: including an integrative approach to abnormal and clinical psychology: Jules H. Masserman. Reviewed by *Carl Binger* 574

Basic electrical engineering: circuits, machines, electronics: A. E. Fitzgerald. Reviewed by *B. R. Teare* 574

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SCIENCE

Vol. 103, No. 2679 Friday, May 3, 1946

Hybrid Seed Corn

George Harrison Shull

Professor Emeritus of Botany and Genetics, Princeton University

IT IS NOW 41 YEARS SINCE I BEGAN the studies of variation in maize as affected by inbreeding, which led me to propose the procedure in corn production that is now generally known as "hybrid corn." My own name for the method was "a pure-line method of corn breeding," and my paper published under this title was read before the American Breeders Association in Columbia, Missouri, slightly more than 37 years ago. I grew my last experimental crop of corn in 1916, 30 years ago.

These facts illustrate well a frequent historical phenomenon, namely, the long interval which may elapse between the making of a fundamental discovery and the general understanding of its importance and full realization of its benefits.

The most notable example of this phenomenon is seen in the discovery and rediscovery of the Mendelian principles of heredity. The chief difference between the history of Mendelism and that of hybrid corn is that within the interval of 35 years between discovery and rediscovery Gregor Mendel died, mindful of the importance of the discoveries he had made, but wholly unaware that 16 years after his death he would receive the recognition that was his due. I have the comfortable distinction of having outlived the interval between discovery and rediscovery, and I now have the satisfaction of knowing that the results of my work will continue to benefit mankind for all time.

In thus expressing my happiness in the thought that my work has been of permanent value, I want you to know that I am fully mindful of the fact that I am only one of many who have made crucial contributions to the benefits that hybrid corn is now giving and will give more and more abundantly with the passing of the years. This award belongs, in reality, to the whole field of workers who have, each in his own way, helped to bring the hybrid corn program with fruly amazing speed so far on its way to full fruition.

In all humility I admit that, regardless of any merit my own work may have to my contemporaries, there would be no hybrid corn now had there been no one else with vision, courage, enterprise, and persistence to carry on from where I left off in 1916. I like especially to think of Edward Murray East, Henry A. Wallace, Donald F. Jones, F. D. Richey, Merle T. Jenkins, W. Ralph Singleton, and many other workers at the Agricultural Experiment Stations, as well as at least a dozen great commercial companies which are now producing the major part of the many millions of bushels of hybridized seed-corn required by American farmers each year.

Some seven years ago at the annual dinner of the American Society of Naturalists held in New York City, I sat between Dr. Ivey F. Lewis, of the University of Virginia, who was then president of the Society, and Dr. William J. Robbins, the newly-appointed director of the New York Botanical Garden.

The John Scott Medal Fund **derives from a gift of John Scott, chemist, St. Patrick's Square, Edinburgh, Scotland, to the city of Philadelphia in 1816. The original amount of the bequest was $4,000, and by 1917 the principal sum had grown to $100,000, whereupon court action was taken to increase the amount of annual awards from the original stipulated value of $20. Almost 500 awards have been made in the 130 years that the fund has been in existence. Between 1920 and 1945 ninety-five awards have been made under the sponsorship of the advisory committee which is at present composed of: Arthur H. Compton, Edwin G. Conklin, Harry L. Frevert, J. F. Metten, Thomas A. Shallow, Harlow Shapley, J. E. Shrader, Philip C. Staples, Harold C. Urey, S. M. Swaab (secretary), and Ernest T. Trigg (chairman).**

In 1945 there were several recipients, among whom Dr. George H. Shull, the originator of hybrid corn, was one.

Dr. Robbins opened conversation by asking me why I stopped working with corn, and my answer was that I had completed my part of the program. I had discovered the basic principles, had formulated them in 12 succinct statements, had invented a method of procedure, and had pointed out the important advantages the proposed program offered to agricultural practice—the assurance of greater yields and greater uniformity, sharper specialization to fit different regions, different climates, different soils, and the production of strains having to a superlative degree any desired chemical content or any other desired qualities. I had recognized for the first time in the history of science, I believe, the reciprocal relation between the deterioration due to inbreeding and the increased vigor due to crossing as the two aspects of a single phenomenon.

In an invitation lecture delivered at Göttingen, Germany, in July 1914, I had urged practical breeders of both plants and animals to make conscious use of hybrid vigor as a theretofore unrecognized source of economic gains. In that lecture I had proposed the word "heterosis" for the stimulating effect of the union of unlike germ cells—a word which has now been widely accepted in genetical textbooks. I had specifically urged the Agricultural Experiment Stations in the corn belt states to work out the problems necessary for the utilization of these principles and methods in practical corn production, pointing out that such problems of practical application lay outside the field of my own responsibility as staff member of the Station for Experimental Evolution, a laboratory established by the Carnegie Institution of Washington for research in basic biological science.

The solution of these practical problems came from two important and unanticipated innovations: Dr. Donald F. Jones, of the Connecticut Agricultural Experiment Station, proposed the double cross, and Henry A. Wallace formed the Pioneer Hi-Bred Corn Company to produce and sell to the farmers the hybridized seed corn. Both of these steps were absolutely essential to the success which has come to hybrid corn.

The Meaning of "Hybrid Corn"

I would like to explain now as briefly as I can just what we mean by hybrid corn, for in this expression we are using the word "hybrid" in a very special sense. Nearly everyone I meet these days has heard of hybrid corn, but it is infrequently that I find one who knows just what it is that makes it "hybrid corn." Earlier biologists and laymen generally used the word "hybrid" to mean the offspring from the mating of two parents belonging to different species, as, for example, in the universally known case of the mule produced by mating a mare to a jackass. In modern genetics the meaning of the word "hybrid" has been extended to all cases in which the parents differ in one or more hereditary traits. The result is that hybrids which were in the old sense relatively rare occurrences have come to be in the new genetical sense of almost universal occurrence in cross-breeding organisms. Only under systems of self-fertilization of hermaphroditic plants and animals do we find hybrids rare or nonexistent.

Although corn is a hermaphroditic plant, it self-fertilizes naturally only occasionally. The tassel at the top of the stem consists of the male flowers, which shed their pollen only when they are shaken by the wind. This pollen is so light that the slightest breeze will carry it away from the plant on which it is formed, thus making it mechanically difficult for the silks, or female flowers located about midway of the stem, to receive the plant's own pollen. This ensures that practically every plant in a field of corn as ordinarily grown is a hybrid in the modern genetical sense. This was the first basic fact that I discovered about corn, and it provided the subject matter for my first corn paper, "The composition of a field of maize," which I read before the American Breeders Association in Washington, D. C., in January 1908, and which was published later the same year in the yearbook of the Association. Keeping in mind this demonstration that practically every corn plant is a hybrid—what can we mean by the term "hybrid" corn that will differentiate it from the natural hybrids in the ordinary field? The distinctive feature of "hybrid corn," as the term is now generally used, lies in the fact that the *promiscuous* hybridization of the ordinary field of corn is replaced by *completely controlled* hybridization in the production of the hybridized seed corn from which the modern so-called "hybrid corn" is grown.

Economic Importance of Hybridizing

The manner in which this control is established is very simple. Self-fertilization of the individuals in a hybrid progeny results, in the course of a few generations, in analyzing that hybrid into a group of pure lines which together may possess all of the hereditary elements present in the hybrid with which the self-fertilizations were initiated. If this original hybrid was very complex, each individual pure line derived from it may be unique in possessing a combination of hereditary elements different from that which characterizes each other pure line of the same derivation. When this stage of "purity" has been established by repeated self-fertilizations, we have in hand the elements for the production of various kinds of hybrid corn. Each kind of hybrid corn is produced

by the definite combination of two, three, or four of these pure lines. Each given combination results in a hybrid which may then be compared with the hybrids produced by other definite combinations, and it is found by this comparison that some of these hybrids are superior in yield and/or desired qualities. When such a superior hybrid has been found, it can be maintained and perpetuated year after year in only one way, namely, by keeping the appropriate pure-bred strains (pure lines) carefully self-fertilized every year and by repeating the same combination of pure lines every year. These tedious and relatively expensive processes must be carried out with meticulous care and are too complicated to be handled by the ordinary farmer. For this reason the successful fruition of the hybrid corn program had to await the establishment of a new industry, that of the commercial corn hybridizers, led by the pioneering work of Henry A. Wallace in the establishment of his Pioneer Hi-Bred Corn Company. When the farmer wants to duplicate the splendid results he has had one year with hybrid corn, his only recourse is to return to the same hybridizer from whom he secured his seed the previous year and obtain again the same hybrid combination. He must pay twice as much for his seed corn than he was accustomed to pay for the best selected seed corn before hybrids became available, but this expensive seed corn adds only about $.50 to $.75 per acre to the former cost, and from the investment of this added $.50 to $.75 he increases his yield from that acre by about 25 per cent.

The hybrid seed industry has grown by leaps and bounds. Wallace's company now grosses more than $1,000,000 annually, and several still larger companies are approaching, if they have not already passed, a $10,000,000 annual turnover.

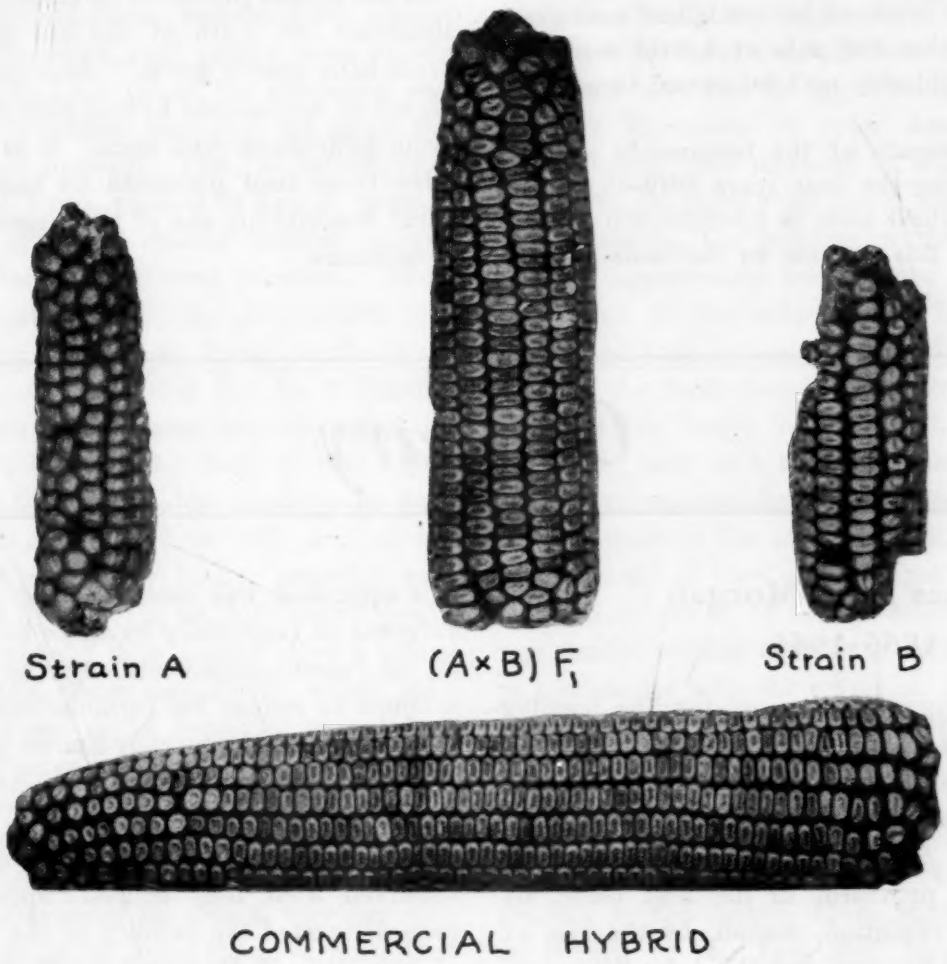

FIG. 1

MONEY VALUE OF HYBRIDIZING

The increase of 25 per cent on a crop amounting to $3,000,000,000 annually so far transcends our powers of comprehension that I prefer to make no statement of my own on the magnitude of the contribution which has resulted from the use of the new methods, lest I seem to be exaggerating. Instead, let me quote a recent authoritative statement made by Dr. Louis J. Stadler, of the University of Missouri, testifying before a subcommittee of the Committee on Military Affairs, of the U. S. Senate on the subject of Science Legislation. Dr. Stadler said in part:

We know from the crop estimates of the United States

Department of Agriculture what fraction of the corn planted in each county was planted from hybrid seed, and we know from numerous and widely distributed field experiments the comparative performance of different strains of corn when grown side by side under identical conditions. In these experiments adapted hybrids consistently outyield the varieties of corn formerly grown, with an average margin of over 25 per cent.

This is an increase in yield which costs nothing except the added cost of producing the special type of seed and the added cost of harvesting a larger crop. In practice the seed is commonly produced by specialized seed growers, and the production and sale of hybrid seed corn has now become an industry with an annual turnover of about $75,000,000.

A conservative estimate of the increase in national corn production during the four years 1942–45, due to the partial use of hybrid corn, is 1,800,000,000 bushels. The money value of this increase on the basis of farm price per bushel is more than $2,000,000,000.

It is, therefore, no exaggeration to say, speaking in terms of the over-all national economy, that the dividend on our research investment in hybrid corn, during the war years alone, was enough to pay the money cost of the development of the atomic bomb.

Fig. 1 shows three ears of corn from my experimental crop of 1912, one ear each from my purebred strains, designated in my papers as Strains A and B, and the hybrid produced by crossing A with B. These illustrate the truth of the old saying: "Great oaks from little acorns grow." Also shown in the figure is an ear of commercial hybrid corn of recent production from hybridized seed corn. It is a hybrid grown in 1940 from seed produced by the De Kalb Agricultural Association, one of the largest of the commercial hybridizers.

Obituary

Thomas Hunt Morgan

1866-1945

Thomas Hunt Morgan was an outstanding member of what may be called the heroic generation of American biologists—those whose work raised American biology to a position second to none among the countries of the world. This was the generation which, under the stimulus provided, in the first place, by Darwin's theory of evolution, second, by the rise of cell study in Central Europe, and third, by the sensational results of the experimental method of approach to problems of generation and development, set afoot that great series of researches in these related fields which made all general biology a really exact science, and which gave hope that ultimately the gap between it and the sciences dealing with inanimate matter could be bridged. With respect to both its versatility and the far-reaching nature of the conclusions convincingly established by a continuation of the lines of attack opened by his pioneer experiments, Morgan's work stands pre-eminent among the accomplishments of his generation.

Morgan's nature was iconoclastic: he took no stock in the pseudophilosophical mumbo jumbo rampant among many biologists even in the era immediately following Darwin, and would not let himself be overawed by the air of mystery surrounding such subjects as regeneration, embryology, heredity, and evolution. His approach was essentially of the type sometimes referred to (especially by those out of sympathy with it) as "mechanistic," although he did not commonly attempt to reduce his formulations all the way down to the level of the already-known physics and chemistry. As an ardent believer in, and practicer of, experiment, and again experiment, in whatever field, he belonged to that group which at the same time so abhorred what they termed "speculation" that they even distrusted the validity of the most essential lines of reasoning of Darwin himself, and he was a leader in that wave of skepticism whose participants "doubted the doubt till they doubted it out." Perhaps biological progress might have been even more rapid if the wheat had not been thrown away with the chaff, yet the end result of the skepticism, since it was combined with experiment and exact observation, was to lead some of this generation, and most of the next, to a vindication of the Darwinian essentials after all, and to an effective implementation of the Darwinian theory which joined it up with a scientific view of living matter in general. It is unusual to find a man who, like Morgan, is willing so to go back on his early preconceptions when the empirical facts demand it.

Starting out along morphological lines, Morgan, following Roux and Driesch, early went over to the experimental attack on problems of development, and his work helped to establish rational interpretations of such phenomena as the polarization of the frog's

egg. His prolific work on regeneration pointed up a number of important problems in this field also and aroused much other American work on the subject, while his attempts to explain the phenomena of regeneration and development on a common basis, and in a rational way, as by the hypothesis of the influence of mutual pressures, though not finally confirmed, showed that there were grounds for hope of solutions being obtained here by experimental means. Turning to problems of evolution, he joined with those who called for more empirical facts, welcomed the results of the experimental breeders, and, after a more purely critical period in these lines (as in his *Evolution and adaptation* and *Experimental zoology*), set about the spadework in earnest himself. The "Mutation Theory," initiated by de Vries, seemed to him to provide a way out for the origin of species because he was distrustful of the theory of natural selection. Thus, when it appeared that the fruit fly, *Drosophila,* was amenable to breeding studies, as shown in the work of Castle, Moenkhaus, Lutz, and (in the Columbia laboratory itself) Payne, Morgan eagerly seized on this material for finding out the facts at first hand. Everyone knows of his remarkable assiduity in finding mutations, from about 1909 to 1912, and of the facts that they did not, individually, establish new species after all and did not (as he, following Darwin on this point, had thought they might) show a qualitative relation to the conditions under which they occurred, or a tendency to be repeated more often in a given direction after having once occurred. Undaunted by these seeming negatives, however, Morgan deflected the direction of his search and studied the method of their inheritance once they had occurred.

It was this reorientation of his attack, together with a concentration of attention upon those variants that could be recognized more definitely, which enabled Morgan to follow the transmission of sex-linked genes in *Drosophila* and so to show that this conformed with the chromosomal pattern which Miss Stevens had found cytologically in that organism. From this preliminary (which, after all, was more or less paralleled in other forms) Morgan passed on to what undoubtedly stands as by far his greatest contribution: the setting up of the genetic case for crossing over. This involved the obtaining of data which showed, first, that different genes connected with the same pair of chromosomes (the X) undergo interchange, and second, that they do so with various frequencies, all of them below that of random relations—that is, they are "linked." It involved, further, the recognition that these facts are just what is to be expected on the "chiasmatype" theory which had already been proposed by Janssens, especially if, as Morgan himself pointed out should be the case, genes further apart have more crossing over between them. This served as the forerunner to a multitude of researches by numerous workers, at first mainly on the *Drosophila* material, which have served to vindicate the crossing-over theory and along with it the chromosome theory of heredity in general.

That the early findings of Morgan were so quickly followed up and generalized upon was due in no small measure to his having opened the doors of his laboratory and, indeed, of his mind to a group of coworkers, already trained in the chromosome theory by Wilson, who chose entirely their own leads and who would not have had the opportunity to carry on freely in most European or even American laboratories. Had Morgan been more of an authoritarian and less willing to be merely an equal member of the group in discussions, the younger workers would not have had the opportunity they needed for the further development of the subject, and Morgan's own mind would not have become so opened to the full implications of the facts found in the *Drosophila* work as to have led him finally to agree that, after all, they lead inevitably back to a theory of natural selection, now on a more rational basis and provided with an elaborate mechanism for its operation. Morgan was won to this point of view only against his own very active opposition, yet it is to his enduring credit that he was finally willing thus to alter his whole viewpoint in accordance with the empirical facts. Having done so, he was able through the series of hammer blows of his successive expositions of the subject to persuade the world of the truth of this point of view. However much the story of the formative period of the *Drosophila* work may be rewritten and reappraised in the future, there must remain agreement in regard to the fact that Morgan's evidence for crossing over and his suggestion that genes further apart cross over more frequently was a thunderclap, hardly second to the discovery of Mendelism, which ushered in that storm that has given nourishment to all of our modern genetics.

H. J. MULLER

Indiana University

Clarence Erwin McClung

1870-1946

C. E. McClung died suddenly on 17 January 1946 at the age of 75. Thus, one more of that group of brilliant zoologists who appeared on the horizon of American science at the turn of the century has passed on. He was born at Clayton, California, on 5 April 1870, but spent most of his earlier years in Kansas, where he grew up, received his education, and became established in his professional career. As a boy he

displayed an interest in chemistry and subsequently studied pharmacy at Kansas University, receiving the Ph.G. degree in 1892. After teaching chemistry and pharmacy at the University for a year, he entered the college and then continued in graduate work. He also pursued graduate studies for one semester under E. B. Wilson at Columbia University and for one summer with W. M. Wheeler at the University of Chicago. Kansas University awarded him the A.B. degree in 1896, the A.M. in 1898, and the Ph.D. in 1902.

Interest in zoology arose through contacts with S. W. Williston, who introduced young McClung to animal histology and vertebrate paleontology. At the suggestion of Prof. Wheeler he undertook a study of the spermatogenesis of *Ziphidium fasciatum,* a "long-horned" grasshopper. In this material "a peculiar nuclear element," which others working on different insects had considered to be a nucleolus, was shown by McClung to be a chromosome. Although not the first to discover that this element was distributed to one-half the spermatozoa, apparently he was the first to see the significance of this fact in relation to sex determination. This interpretation, first announced in 1901, brought him world-wide recognition and initiated a lifetime of researches on the chromosomes and their relation to taxonomy and evolution.

In addition to his numerous papers on chromosomes, Dr. McClung's publications reveal a wide range of interests including pharmacy, paleontology, microtechnique, photography, and a variety of educational and philosophical subjects. Interest in the microscope and in the techniques related to it resulted in the design of a "McClung Model" research microscope and in the publication of the *Handbook of microscopical technique,* prepared with the help of a group of collaborators.

As a teacher, Dr. McClung sought to develop the natural capabilities of each student. In the elementary course in zoology, which he taught at Kansas University, he introduced "unknowns" to arouse the spirit of inquiry which most young people possess but which is too often suppressed by current methods of college instruction. As editor of the *Journal of Morphology* from 1920 until his death, he labored to help authors, especially the younger ones, to appreciate the best methods of writing scientific papers.

Dr. McClung's keen intellect, genial personality, and administrative ability brought him many responsibilities both inside and outside the universities which he served. At Kansas University he was made chairman of the Department of Zoology in 1901 and curator of vertebrate paleontology in 1902, and he served as acting dean of the Medical School from 1902 to 1906. He was also chairman or member of many administrative committees.

In 1912 Dr. McClung was called to the University of Pennsylvania as director of the Zoological Laboratory. Here, through committee assignments and in other ways, he worked for progressive changes in curricula and improvements in facilities for graduate studies and research.

At the Marine Biological Laboratory, Woods Hole, Massachusetts, Dr. McClung became trustee in 1913, a member of the investigative staff in 1914, and served as chairman or member of the committees on new permanent buildings, endowment, the library, and the executive committee.

In 1917 Dr. McClung was made chairman of a zoology committee of the Division of Biology and Medicine of the National Research Council and in 1919 became the first chairman of the new Division of Biology and Agriculture, which he helped to organize. He was also a member of the Division of Educational Relations of the Research Council. He was the first president of the Union of American Biological Societies (1922–30), which, with other organizations, sponsored *Biological Abstracts,* and from 1925 to 1938 he served as president of the latter's board of trustees.

Various interests and responsibilities took Dr. McClung abroad. In the summer of 1924, accompanied by Dr. Schramm, then editor of *Biological Abstracts,* he toured Europe in the interests of this new abstracting service. The academic year 1927–28 was spent in travel, research, and writing in Europe. In 1930 he was the delegate of the U. S. Government, the American Philosophical Society, and the National Academy of Sciences at the International Congress of Biology at Montevideo. In 1933–34 he went to Japan as visiting professor at Keio University, Tokyo, returning through Europe. In 1939 he made a collecting trip to South Africa and completed a second trip around the world.

Among the executive offices held by Dr. McClung were also the following: president, Central Branch, American Society of Zoologists (1910), combined Zoological Society (1914), American Naturalists (1927), National Society of Sigma Xi (1917–21), Beta Beta Honorary Biological Fraternity (1936 onward); vice-president, Section F (Zoology), AAAS (1926). He was a member of the American Philosophical Society and of the National Academy of Sciences.

A degree of Doctor of Science was awarded to Dr. McClung by the University of Pennsylvania in 1940 and by Franklin and Marshall College in 1942. During 1940–41 he was acting chairman of the Department of Zoology at the University of Illinois, and in 1943 he became acting chairman of the Department of Biology at Swarthmore College.

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Technical Papers

Occurrence of Mitotic Crossing-over Without Meiotic Crossing-over

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The occurrence of crossing-over has been demonstrated not only during the meiotic cycle but also during mitotic multiplication of cells in certain plants and animals (*2, 6–9*). The purpose of the experiment to be reported here is to see if the gene c3G in *Drosophila melanogaster* which nearly eliminates meiotic crossing-over also suppresses mitotic crossing-over.

C3G is a recessive gene in the third chromosome (*5*). Externally it produces no visible effect in either homozygous or heterozygous constitution. However, it eliminates nearly all meiotic crossing-over in the first, second, and third chromosomes and causes frequent nondisjunction of chromosomes I and IV as well as the production of intersexes, supersexes, triploids, and numerous sterile eggs. It presumably acts by nearly eliminating meiotic pairing in the female, the nonsynapsed chromosomes being distributed at random without having undergone crossing-over (*3*).

Mitotic crossing-over can be studied by means of mosaic spots due to crossing-over in somatic cells ("somatic crossing-over"). The latter will result in groups of cells homozygous for genes carried initially in heterozygous condition in the developing zygote. Genes in the X-chromosome were chosen for the present study, and females carrying recessive sex-linked genes in heterozygous constitution were obtained. The genes had to be suitable to produce observable effects in small patches of cells on the surface of flies whenever the cells had become homozygous due to crossing-over. Genes meeting these requirements are y (yellow body color, 1, 0.0) and sn^3 (singed bristles, 1, 21.0). In order to obtain flies homozygous for c3G and heterozygous for the genes y and sn^3, two stocks were employed: (1) homozygous for the normal alleles of y and sn^3 and also homozygous for c3G (++;c3G), and (2) homozygous for y sn^3 and also homozygous for c3G (y sn^3;c3G). For the latter stock we are indebted to Miss Eva Rosenow (Mrs. Fred Sherwood). Flies of both stocks were crossed reciprocally, and the F_1 female offspring (y sn^3/++; c3G/c3G) were examined for the occurrence of mosaic spots. Since crossing-over occurs at the four-strand stage in somatic cells as well as in meiosis, yellow singed spots indicate crossing-over between the kinetochore and the sn locus, yellow spots result from crossing-over between the y and sn loci, and singed spots from double crossovers.

As a check on the ability of the observer to identify spots a control cross of y sn^3 females to wild-type males and the reciprocal cross were made. Spots due to somatic crossing-over were observed on more than 21 per cent of the F_1 females. Since c3G flies are indistinguishable from flies not containing this gene, contamination or errors during the building up or the keeping of c3G stocks do not automatically become obvious. Therefore, as a check on the purity of the c3G stock, crossover tests were made before and after the experiment. These tests confirmed the absence of crossing-over in all cases. The low viability of the stock and high percentage of nondisjunction in both chromosomes I and IV during the experiment also served as a check on the presence of c3G.

In spite of the presence of c3G which suppresses crossing-over in meiosis, not less than 22 per cent of the flies examined showed somatic spots due to mitotic crossing-over. This compares with a frequency of 21.5 per cent in the "control" (Table 1).[2] Therefore, the elimination of meiotic crossing-over is not associated with an effect on mitotic crossing-over in somatic cells of Drosophila females.

TABLE 1

	Flies examined	Flies with spots	Per cent flies with spots	Total no. of spots	Per cent spots	Description of spots		
						y sn	y	sn
Control	93	20	21.5	26	27.9	15	6	5
Experiment ...	71	16	22.5	18	25.3	13	4	1

The result reported is not entirely unexpected because (1) Friesen reported spermatogonial crossing-over in X-rayed males (thus, mitotic without meiotic crossing-over, since there is no crossing-over in the male); (2) Gowen (*4*), after X-raying c3G flies, found somatic spots (eye mosaics); (3) Stern (un-

[1] The writer is gratefully indebted to Dr. Curt Stern for suggesting the experiment and for his advice and encouragement.

[2] Since these figures are much higher than those reported in other studies of the same somatic changes (*1, 7*), it might be mentioned here that though some of the spots involved as many as five hairs, many spots were determined on the basis of a single hair. Undoubtedly, however, differences between the genetic background of the flies used in different experiments also contribute to the variability of frequency of spots observed.

published) saw regular pairing in the oögonial cells of homozygous c3G flies; and finally, (4) Dr. Jack Schultz permits me to quote him as having observed regular pairing in the salivary glands and in the endomitotic nerve cells of the ovary of homozygous c3G animals.

By themselves, however, these former results are not decisive, since in (1) and (2) they could have been attributed to special X-ray effects and since regular pairing in (3) and (4) does not necessarily signify crossing-over. Only some data on autosomal somatic crossing in untreated males (7) are of similar significance as the data reported here, which give evidence of mitotic crossing-over in untreated females homozygous for c3G.

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Linkage and Crossing-over Between Black Pigmentation and Susceptibility to Induced Fibrosarcoma in Mice[1]

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Evidence has been published which indicates that germinal mutations have been induced in mice by chemical means. These germinal changes occurred in mice whose parents and grandparents had been injected subcutaneously with methylcholanthrene for a number of generations. More recently it has been determined that one of these germinal mutations (recessive brown pigmentation to dominant black pigmentation) has also apparently involved the genetic mechanism which determines, in part, susceptibility to fibrosarcoma induced at the site of methylcholanthrene injection. Thus, the black mutants possess a tremendously enhanced susceptibility to fibrosarcoma above the susceptibility possessed by mice of their ancestry or even their brown litter mates. Further unpublished evidence has shown that of the mice of the 15 inbred strains developed by the author and tested for susceptibility to fibrosarcoma, all, irrespective of genetic origin or relationship, that possess the black gene show a higher susceptibility to induced fibrosarcoma than any mouse of any of the strains possessing the brow gene. Thus, a linkage experiment is clearly indicate

The F_1 from a cross between the original brow ancestral stock (NHO descent) and the black mutan possess the susceptibility of the black mutants (dom nant inheritance). The F_1 generation consisted of mice, all showing the dominant black. In the bac cross generation to the recessive brown stock, 235 mi have been obtained and tested for susceptibility induced fibrosarcoma. Of these, 121 were black a 114 brown (expected on Mendelian theory, a 1 ratio). The black backcross mice retain the suscep bility of the black mutants and the F_1's, whereas t brown backcross show the low susceptibility of t ancestral brown stock. Thus, linkage between bla hair color and susceptibility to induced fibrosarcom has been demonstrated.

The late survivors of the F_1 (that is, those mi living beyond 75 per cent of the total F_1's) show so degree of resistance, since it takes a longer time f them to develop fibrosarcoma at the site of injectio Therefore, if this tendency to greater resistance fibrosarcoma is due to the loss of the hypothetical hi susceptibility "gene" through the process of crossing over, it ought to be possible to demonstrate this b the investigation of their descendants. This has be done, and when mice of one subline (of three separa ones tested) of the black mutant derivatives, suspect of possessing low susceptibility to induced fibrosar coma even though they were black, were outcrossed t the ancestral brown stock, the F_1's (255 mice) showe the fibrosarcoma susceptibility of the resistant brow stock mice. A new black subline derived from thes resistant F_1 black mice continued to show the low su ceptibility of the brown mice.

The present evidence would indicate that on th "black" chromosome there is a gene that determine high susceptibility to induced fibrosarcoma; on th "brown" chromosome, a gene that determines low su ceptibility or resistance to the same induced neoplasm In the data reported here it appears that the proces of crossing-over has occurred between the black gen and the S^{fs} (susceptibility to induced fibrosarcoma gene. Thus, the evidence is accumulating that th intrinsic or genetic nature of resistance and suscep tibility to induced fibrosarcomas is beginning to b indicated; that is, a mouse develops a fibrosarcom following the subcutaneous injection of methylcholan threne because it has a peculiar configuration in it genetic constitution determined by genes which ap parently obey the same laws of Mendelian heredity (linkage and crossing-over) as the genes that deter mine hair pigmentation, etc. One of the genes, th S^{fs}, is on the same chromosome that carries the gen for black pigmentation.

[1] This experiment has been made possible by grants from The Anna Fuller Fund and The Jane Coffin Childs Memorial Fund for Medical Research.

aploidy as a Factor in the Poly-orphic Differentiation of e Hymenoptera

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Polymorphism, or the existence within a species of o or more adult forms of the same sex, is characteric of many insects. In the Hymenoptera, polyorphism appears to be an effect of nutritional difrences which occur during ontogeny (*13, 14, 16*).

The degree of polymorphic differentiation apparntly varies with the developmental stage in which ifferentiation is induced. Differentiation induced uring the larval stage, as in the honey bee (*16*), and *elittobia chalybii* (*14*), is much less marked than that duced earlier in development during the primordial rm cell stage, as is apparently the case in the alterating generations of the gall wasps (*Cynipidae*) *7, 9*).

Polymorphism plays an important part in the econmy of a species when it forms the basis of a social rganization, as in the aculeate Hymenoptera and the soptera (*Termitidae*).

In the Hymenoptera, however, the occurrence of olymorphism is limited by haploidy, a phenomenon nknown in the Isoptera, in which the sexes are iploid and equally polymorphic (*10*). In the Hymenptera only the female is normally diploid, and olymorphism is largely limited to that sex. This is ot because haploidy in itself is inimical to polyorphism, for species exist in which polymorphism s limited to the haploid male (*1, 13*).

It would appear that the relatively low incidence f male polymorphism in hymenopterous species is n effect of the male not being subjected to the conitions which cause polymorphic differentiation or, if o subjected, of not being able to reach maturity.

Haploidy is known to be lethal in several species of parasitic Hymenoptera (*11, 12, 15*), nonpolymorphic as well as polymorphic. It is significant that haploidy appears lethal only in species which show a disinclination to oviposit before mating (*5*).

In most species that oviposit as readily before as after mating haploidy is rarely, if ever, a factor in the failure of the egg to hatch. It is evident, therefore, that haploidy may be lethal only if it is associated with some condition of the egg brought about by the disinclination to oviposit.

Most Hymenoptera are highly specialized in their selection of sites for the deposition of their eggs. Consequently, it is not surprising that in many species of Hymenoptera, particularly in those in which the female is long-lived, oösorption occurs if suitable oviposition sites are lacking (*4*). When the rate of egg deposition is relatively low, a relatively high proportion of the eggs deposited may be partially absorbed. In a mated female such eggs are more likely to be fertilized than eggs deposited rapidly and not subjected to the oösorptive process.

Whiting (*17*) has observed that in *Microbracon hebetor* more nonhatching eggs were obtained from females mated with related males than from females unmated or mated to unrelated males. The higher mortality of the eggs from the close-crosses in *M. hebetor* is reported by Whiting as due to the lower viability of the diploid individuals. Since it is quite possible that females mated with related males are more disinclined to oviposit than females mated with unrelated males, the former may deposit more partially absorbed diploid eggs than the latter. Such eggs may account for the polymorphism exhibited by inbred stocks of *Microbracon* (*6*).

In species in which the unmated female is disinclined to oviposit, the haploid male progeny are produced the greatest numbers when oviposition by mated females occurs at the maximum rate. It is then that the highest proportion of eggs escape fertilization and oösorption is at a minimum (*2*).

If the haploid hymenopterous egg, upon losing part of its content by absorption while in the ovariole, loses its capacity for hatching, it may regain this capacity by becoming diploid through fertilization. This probably would be necessary if polymorphic differentiation is determined by the partial absorption of ripe ovarian eggs (*8*).

In this connection it should be noted that in polyembryonic species it may be the mere addition of sperm to an egg that enables that egg to produce more embryos (*3*) than it would if unfertilized.

It is significant that in endoparasitic species—that is, species which place their eggs in position to absorb nutrient from the host—polymorphism appears to be limited to the haploid individual (*1, 13*). It is known in the case of the endoparasitic *Trichogramma semblidis* that polymorphic differentiation is determined by the kind of host.

Polymorphic individuals in species in which differentiation is determined by the partial absorption of the ripe ovarian egg (which is a point about midway in ontogeny) should be more strongly differentiated than the queen bee and worker and less so than the alternating generations of certain gall wasps. The oösorptive process apparently has a graduated effect on the eggs which would allow for the fullest expression of the polymorphic potentialities inherent in the germ plasm.

In the Hymenoptera, polymorphism finds expression commonly in diploid individuals, rarely in haploid individuals. In many, if not all, polymorphic species, under natural conditions, the production of diploid eggs greatly exceeds that of haploid eggs.

In social species the low incidence of male polymorphism may result either from the mortality of the partially absorbed unfertilized egg, from the fertilization of all the partially absorbed eggs deposited, or from the relatively small nutritional needs of haploid individuals.

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Carcinogenic Substances From Pituitary Glands of Cattle

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The discovery of carcinogenic chemical substances suggested that in certain conditions analogous substances are produced within the organism and thus become responsible for cancerous growth.

Schabad (*12, 14, 15*) obtained a lipid extract from the liver of a patient who died of stomach cancer, and this extract, when injected into white mice, induced malignant tumor growth in some of the animals treated.

In further investigations Schabad, *et al.* (*4, 5*) prepared extracts of human livers from cancerous as well as noncancerous individuals. Of the white mice injected with these extracts about one-third died within the first few months of the experiment. A number of animals which lived to an age of more than 8 months following the first injection developed malignant tumors.

The findings of Schabad were confirmed by other investigators (*1–3, 13, 16–19*).

It must be added that Menke (*10, 11*) injected lipid extracts from human mammary cancers into white mice, and of 36 mice injected, 7 developed sarcomas after 7 to 14 months.

The above experiments indicate that carcinogenic chemical factors of a lipid nature are present in the cancerous as well as in the normal organism. Thus the question arises as to the origin of these substances.

For investigation of this problem we employed our previous studies, which indicate that the pituitary gland is connected in a hormonal way with the development of cancer (*6, 7*). We therefore examined extracts of the pituitary gland for presence of carcinogenic hormonal factors.

Experimental

In our experiments fresh pituitary glands from cattle were freed from adjacent tissues and the anterior and posterior lobes of the gland carefully separated. One hundred posterior lobes or 50 anterior lobes were used for the preparation of each lipid extract.

The glands were extracted with acetone, ethyl ether and alcohol, and the brownish oil obtained was suspended in sweet almond oil and injected subcutaneously into white mice of our own breeding. Our purebred strain of mice has a low incidence of spontaneous tumors (two mammary tumors in 1,700 mice).

The amount of extract obtained each time varied from 300 to 800 mg. The animals received 10 to 30 mg. each as a single injection, no difference in the effects being noted with variation of the dose within these limits.

Four extracts were prepared from the anterior pituitary, and 32 white mice were given a single injection of the extracts.

Seven mice died during the first 4 months of the experiment. Of the remaining 25 animals injected with the anterior lobe extracts, 9 developed malignant tumors: 4 females developed breast cancer (after 7, 7, 10, and 14 months), 1 male and 1 female developed carcinoma at the site of injection (after 13 and 6 months), 1 male and 2 females developed liver cancer (after 8, 9, and 8 months).

Of the 16 animals which died without developing tumors, the individuals survived as follows: 3 for 7 months, 3 for 8 months, 2 for 10 months, 1 for 11 months, 2 for 12 months, 3 for 13 months, 1 for 14 months, and 1 for 19 months.

Of the four extracts prepared from the anterior lobe, one caused no malignancy in the animals injected, while another provoked 5 various tumors in 6 injected mice. The remaining two extracts provoked malignancy in 20.6 per cent of the animals injected.

Five extracts were prepared from the posterior lobe of the pituitary gland, and 35 animals were given a single injection of the extracts.

Twelve mice died during the first 4 months of the experiment. Of the remaining 23 animals injected,

9 developed malignant tumors: 3 females developed breast carcinoma (after 5.5, 16, and 19 months), 1 female and 2 males developed lung carcinoma (after 18, 16, and 22 months), 1 male developed liver carcinoma (after 11 months), and 2 males developed sarcoma at the site of injection (one lymphosarcoma after 9 months, and one spindle cell sarcoma after 11 months).

Of the 14 animals injected and dying without developing tumors, the individuals survived as follows: 1 for 9 months, 2 for 11 months, 3 for 13 months, 3 for 15 months, 1 for 16 months, 2 for 17 months, 1 for 19 months, and 1 for 22 months.

Of the five extracts prepared from the posterior lobe, one caused no malignancy in the animals injected, while another provoked 3 breast cancers in 4 mice injected. The remaining three extracts provoked malignancy in 25.4 per cent of the animals injected.

Discussion

In our experiments lipid extracts prepared from the beef pituitary and injected into white mice provoked the growth of malignant tumors in a number of the animals injected. Extracts from the anterior lobe as well as extracts from the posterior lobe of this gland were equally active, provoking malignancy in 26.8 per cent of the animals used in the experiments.

The malignant tumors usually developed in organs at a distance from the site of injection, only 4 animals (of 18) developing cancer at that place.

The malignancy appeared in various histological types including carcinoma as well as sarcoma.

The only difference in the carcinogenic activity noted between the extracts of the anterior lobe and those of the posterior lobe of the gland involves the time of development of tumors after injection. The tumors developed earlier after injection of the anterior lobe extracts than after injection of extracts of the posterior lobe. Of the 9 cancers observed in each of the two experimental series, 8 developed during the first 10 months of the experiment in the series injected with anterior lobe extracts. During that period of time only 2 cancers developed in mice injected with the posterior lobe extracts. The calculated average period of time necessary for the development of the tumor is: for anterior lobe extracts, 9.3 months; for posterior lobe extracts, 14 months.

Assuming that the same chemical agent causes malignancy after injection of the anterior or posterior lobe extracts, an additional factor which accelerates the development of tumors must be present in the extracts prepared from the anterior lobe of the gland. The lipid growth-accelerating hormone isolated by Lustig and Wachtel (*8, 9*) from the anterior pituitary lobe can be considered correlated with the causation of this phenomenon as it markedly increases the growth rate of transplantable mice tumors.

The differences in the degree of the carcinogenic activity observed with different extracts prepared from both lobes of the pituitary gland are still to be explained. Many factors may be operative, e.g. differences in response of animals treated, differences in dosage, or imperfection in the method of extraction. It is also probable that the inactive or feebly active extracts include an unknown factor which renders the carcinogenic component ineffective. If that factor is lost during the extraction, the carcinogenic activities of the extract attain full opportunity for their development. Further experiments for clarification of this subject are in progress.

The histological diagnosis of the tumors was verified by Dr. Francis Carter Wood, to whom we are indebted for his coöperation.

Summary

Lipid extracts from the pituitary gland of cattle were prepared which, when injected into a pure strain of white mice, caused development of malignant tumors in 26.8 per cent of the 67 animals injected, which corresponds with the numerical results obtained by investigators working with human liver extracts. Evidently the carcinogenic power of these lipid extracts is low. The tumors developed chiefly in organs at a distance from the site of injection, exhibiting various histological types including carcinoma as well as sarcoma. The tumors developed at an earlier date after injection of extracts from the anterior lobe as compared with those developing after injection of the posterior lobe extracts, the average period of time necessary for their development being 9.3 months for the anterior lobe extracts and 14 months for posterior lobe extracts.

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Science Legislation

Statement Concerning S. 1850

Committee Supporting the Bush Report

On behalf of the 5,000 scientists and others who signed or endorsed our letter to the President dated November 24, 1945, we appeal to the Congress to enact S. 1850, the National Science Foundation Bill introduced February 21, 1946, by Senators Kilgore, Magnuson, Johnson, Pepper, Fulbright, Saltonstall, Thomas, and Ferguson, and recently reported out with approval by a majority of the Senate Committee on Military Affairs. (*Science,* 1946, **103**, 192; 382.)

For the reasons stated in the Bush Report and in the Report on Science Legislation of the Committee on Military Affairs, we are in favor of Federal support for scientific research and education. We are in favor of a National Science Foundation. We are satisfied that, given appointments by the President to the National Science Board solely on the basis of demonstrated capacity and fitness, the Foundation described in S. 1850 will promote and protect the interests of science and will thus serve the public welfare.

While S. 1850 is a compromise, it is a compromise on which most scientists have agreed. Most of the principles for which this Committee has consistently stood have been accepted. Thus there is provision for a strong National Science Board. Though the Administrator will be appointed by the President, the President must consult with and receive the recommendations of the National Science Board concerning the appointment. And the Administrator must consult and advise with the Board on all matters of major policy, program, or budget. The Board has the power to make recommendations to the President and to the Congress independently of the Administrator. The advice and approval of the Board are required for appointment to the Divisional Scientific Committees, the chairmen of which will serve as members of the Board. Except in the case of National Defense, there is no provision for *ex officio* appointments either to the Board or to the Divisional Committees. The Foundation will be endowed with powers sufficient to initiate and carry out an effective program in aid of scientific research and education.

In endorsing S. 1850 and appealing for its prompt enactment, we recognize that many scientists doubt the wisdom of (a) the inclusion of the social sciences in *this* legislation, (b) the provisions affecting the Government's patent policy, and (c) the arrangement for mandatory geographical distribution of funds to state-supported and land grant colleges. While many would be better satisfied if these provisions were dropped, protracted delay or failure to enact this legislation would be far more prejudicial to the public interest than the inclusion of the provisions objected to.

We believe that the creation of a National Science Foundation to support fundamental scientific research and the education of scientists is of the utmost importance for the health, security, and welfare of the nation. Moved by this conviction and recognizing the public responsibility of men of science in these matters, we have, to the full extent of our ability, endeavored to aid the Congress in the formulation of workable legislation. Believing the matter to be of great urgency, we recently joined with other groups in an appeal to the Chairman and members of the Senate Committee on Military Affairs to report a bill on which the majority of scientists could agree. S. 1850 is the result. We endorse this bill and appeal now to the Congress as a whole to create a National Science Foundation by the enactment of S. 1850 before the end of the present session.

Signatories of the Statement which was mailed to the President and the Congress, 23 April 1946

Isaiah Bowman, *Chairman,* Roger Adams, William P. Anslow, Jr., Boris A. Bakhmeteff, G. W. Beadle, Francis G. Blake, D. W. Bronk, William B. Castle, Alfred Chanutin, Walter C. Coffey, Robert E. Doherty, Edward A. Doisy, L. A. DuBridge, F. Malcolm Farmer, Herbert S. Gasser, Ernest Goodpasture, Farnham P. Griffiths, R. F. Griggs, C. P. Haskins, A. C. Ivy, Chauncey D. Leake, E. M. MacEwen, Charles E. MacQuigg, H. L. Marshall, C. S. Marvel, J. S. Nicholas, Alton Ochsner, J. Hugh O'Donnell, Walter W. Palmer, Linus Pauling, A. N. Richards, Homer W. Smith, Kenneth B. Turner, James J. Waring, Bethuel M. Webster, and Lewis H. Weed.

The AAAS Council vote, authorized at the St. Louis meeting, resulted in a clear majority supporting S. 1850; the vote was 223 to 10. This is the time for action. If you favor S. 1850, telegraph or write to *your* Senator now! Mention The National Science Foundation and the number, S. 1850.

News and Notes

J. Robert Oppenheimer, professor of Physics in the University of California, has returned to Berkeley. He will resume his regular teaching duties on the Berkeley campus at the start of the fall semester. He hopes, as in the past, to act as a consultant to the California Institute of Technology. Dr. Oppenheimer has been on leave of absence since July 1942 and served as director of the Los Alamos Atomic Bomb Laboratory, at Los Alamos, New Mexico, from its inception until after the termination of the war. For the past few months he has worked in Washington, as a member of the Board of Consultants to the State Department, which has recently issued a report on the international control of atomic energy. (See *Science,* 1946, **103**, 451.)

Dr. Alpheus W. Smith, dean of Ohio State University's Graduate School and chairman of the University's Department of Physics and Astronomy, will retire during the coming summer. He has held both positions since 1939 and has been a member of the University's faculty for 37 years. Dr. N. Paul Hudson, who has been professor and chairman of the Department of Bacteriology since 1935 and who was professor of bacteriology at the University of Chicago from 1930–1935, will become the new dean of the Graduate School. Dr. Harald H. Nielsen, who has been on the physics faculty of Ohio State University since 1930, will become the new chairman of the Department of Physics and Astronomy.

Byron N. Cooper, formerly of the Virginia Geological Survey and more recently on the staff of the U. S. National Museum, has been appointed head of the Department of Geology at Virginia Polytechnic Institute, Blacksburg. He succeeds Roy J. Holden, who died last December. Dr. Cooper assumed his new duties on 1 April.

Charles A. Doan, dean and director of medical research, Ohio State University College of Medicine, delivered the Fifth Edwin R. Kretschmer Memorial Lecture on Friday evening, 26 April, at the Palmer House before the Institute of Medicine of Chicago. His subject was "Marrow Hematopoiesis (Synthetic Folic Acid) and Splenic Hematopenia: Experimental and Clinical Studies."

Willis H. Johnson, professor of biology at Stanford University, has been appointed professor of zoology and chairman of the department at Wabash College beginning September 1946. Dr. Johnson recently returned to Stanford after seven months service with the Army Educational Program at Shrivenham, England, and Frankfurt, Germany.

William R. Duryee, formerly assistant professor of biology at New York University, has been appointed technical associate, Committee on Growth, National Research Council. He was recently retired from the Army with the rank of major, after five years in the 27th Division and the Office of the Surgeon General. He was chief of the publications section, Training Division, SGO.

Sir Wallace Akers is resigning from his post as director of atomic bomb research at the Department of Scientific and Industrial Research. After a holiday, he will resume his duties on the board of Imperial Chemical Industries, Ltd.—*The Times* (London).

Dr. John P. Gillin, associate professor of anthropology at Duke University since 1941, has been appointed professor of anthropology and research professor in the Institute for Research in Social Science, University of North Carolina, Chapel Hill, effective 1 September 1946.

Dr. George O. Sharp, formerly of the University of Iowa and the American Medical Association Chemical Laboratories, has recently accepted a position with The Wm. S. Merrell Company as assistant chief chemist.

Dr. Benjamin J. Lazan, vice-president and chief engineer of the Sonntag Scientific Corporation of Greenwich, Connecticut, has been appointed associate professor of metallurgy and director of the Materials Testing Laboratory in the College of Applied Science, Syracuse University. He joined the University faculty on 1 May 1946.

Prof. Egidio Meneghetti, director of the Department of Pharmacology and rector of the University of Padova, continued his research activity more or less normally until 1943, when, with the whole staff of his Department and the majority of the university students and many of the professors, he started active "underground" work. Various inspiring papers of Prof. Meneghetti, who became leader of the underground and later of the armed revolt, have been collected in a volume entitled *Scritti clandestini* (Zanocco, Padova, 1945). Among the 33 members of the university who lost their lives were: Prof. Mario Todesco; Dr. Giovanni Carli and Dr. Otello Pighin, assistant professors in the School of Engineering; Dr. Angelo

Curiel, assistant professor at the Faculty of Sciences; and Dr. Matteo DeLuca, assistant professor at the Faculty of Medicine. Drs. Aldo Cestari and Benigno, also members of the Department of Pharmacology, were arrested by the Nazis, while Dr. Lanfranco Zancan, from his hiding place, gave a valuable contribution to the underground work.

The Department is now starting to work and is in need of books, reprints, and periodicals.

Elton J. Wood, of the Research Department, Radio Corporation of America Laboratories, Princeton, New Jersey, addressed the Philadelphia Science Teachers Association on 28 March on "Phosphors and Their Applications in Electronics." The meeting was held in cooperation with Schoolmen's Week at the University of Pennsylvania.

Dr. Arnold L. Soderwall has been promoted from instructor in zoology to assistant professor of biology at the University of Oregon.

Dr. Charles D. Coryell, of the Clinton Laboratories at Oak Ridge, Tennessee, has been appointed professor of chemistry at the Massachusettts Institute of Technology.

Announcements

The staff of the summer course in embryology of the Marine Biological Laboratory, Woods Hole, Massachusetts, has undergone several changes. Dr. Viktor Hamburger, of Washington University; Dr. W. W. Ballard, of Dartmouth College; and Dr. Jane Oppenheimer, of Bryn Mawr College, have resigned from the course staff. The present staff consists of: Dr. Howard L. Hamilton, of the State University of Iowa; Dr. John A. Moore, of Barnard College; Dr. Albert Tyler, of the California Institute of Technology; and Dr. Donald P. Costello, of the University of North Carolina, instructor in charge of course.

The Central Engineering Laboratory, established by the Government in the Towne Scientific School of the University of Pennsylvania for wartime research and development, has been converted into a University of Pennsylvania Thermodynamics Research Laboratory with a shift of emphasis toward fundamental research in thermodynamics, it has been announced by Dr. George Wm. McClelland, president of the University.

Under its new name it will continue to be housed in the Towne School on the University campus and will be maintained under contract with the Navy Department Bureau of Ships as a focal area of fundamental research designed to benefit both governmental and private agencies.

The Central Engineering Laboratory was established early in 1943 under a contract between the University and the Office of Scientific Research and Development, the latter appropriating nearly $1,000,000 for its work.

Possessing exceptionally diversified and extensive facilities for the production of liquid air, liquid oxygen, and liquid nitrogen, the physical plant of the Laboratory occupies 10,500 square feet of floor space in the Towne School, and by June 1947 will have been expanded by almost 10,000 square feet of additional space.

The Thermodynamics Research Laboratory is at present operating under 18 approved task orders, the term applied by the Navy to approved research authorizations, and several more are being considered for approval. There are 52 persons now engaged in its activities, the group including two linguists who translate seized German documents concerned with oxygen production.

"The program of the new laboratory places greatest emphasis on fundamental research," Dr. John A. Goff, dean of the Towne School, stated. "Its principal objective is to fill important gaps in our knowledge of the thermodynamic properties of substances involved in engineering processes and to apply this knowledge to the analysis of such processes as a necessary means for improving them. A corollary objective is the building of a strong program of graduate study and research in the thermodynamics and related fields to which the armed services may send selected officer personnel for advanced training. At the same time the program also calls for moderate activity along developmental lines to the extent that it makes use of the unique facilities of the laboratory not presently available elsewhere. Thus, provision has been made for cooperation with industry in the investigation of practical problems to which the facilities of the laboratory are especially adapted. The work of the new laboratory will be integrated with the Towne School's regular program of instruction, and to that end a number of members of the school's instructional staff are devoting substantial portions of their time to research in the laboratory as project leaders. A particularly significant development also has been the appointment of an advisory committee of outstanding scientists and engineers who will be active in long-range planning and direction of the laboratory's program."

Serving on that advisory committee, Dr. Goff revealed, are Earl P. Stevenson, president of Arthur C. Little, Inc., Cambridge, Massachusetts; Commodore R. V. Kleinschmidt, USNR (Retired); Lt. Cdr. Ashton T. Scott, Navy Department Bureau of Ships; Prof. Gerhard Herzberg, Yerkes Observatory, University of Chicago; Dr. Frederick D. Rossini, National

Bureau of Standards; Prof. Frederick G. Keyes, Massachusetts Institute of Technology; Prof. Maxwell Gensamer, Pennsylvania State College; and Dr. Hiram S. Lukens, Towne Scientific School.

The 50th Annual Meeting of the Michigan Academy of Arts and Letters was held in Ann Arbor on 12 and 13 April 1946. Alexander G. Ruthven, president of the University of Michigan, and Alfred L. Nelson, president of the Academy, gave the addresses at the 50th Anniversary Dinner on Friday evening, 12 April. Among the sections which presented programs at this meeting were those on anthropology, botany, forestry, geography, geology and mineralogy, mathematics, psychology, sanitary and medical science, sociology, and zoology.

The Biological Laboratory, Cold Spring Harbor, is offering a course for research workers, to be given by Prof. Max Delbruck, of Vanderbilt University. The course is designed to acquaint scientists with some of the techniques used in research with bacterial viruses and with recent results of such work. It will be held from 15 July to 2 August.

The New York Hospital, Westchester Division, announces the establishment of a Department of Psychology, according to Clarence O. Cheney, medical director. Edward I. Strongin has been appointed head of the Department, which will be engaged in a systematic research program in addition to providing clinical psychological services. Arthur L. Benton has been appointed attending psychologist.

A position of assistant psychologist has been created and is at present open. Miss Ann Kennard has been appointed psychological interne. Both of the latter positions provide an opportunity for pursuing graduate work in New York City. Interested individuals are invited to write to Dr. Cheney concerning this vacancy.

Dr. Strongin has just returned to civilian life after almost three and one-half years in the Army as classification officer and aviation psychologist, and Dr. Benton has just returned to civilian life after more than four years in the Navy.

The American College of Dentists has authorized the following grants-in-aid for research for the period 1 July 1946 to 30 June 1947:

To H. R. Hunt and C. A. Hoppert, of Michigan State College, is given the sum of $500 for a continuation of their work on the inheritance of dental caries in rats.

To Morris Steggerda, Hartford Seminary Foundation, Hartford, Connecticut, is given the sum of $500 for a study of the incidence of dental caries and the eruption time of teeth of various racial groups located in Africa, India, China, and Latin America.

The Association of Southeastern Biologists held its Seventh Annual Meeting on 19 and 20 April 1946 at the University of South Carolina, Columbia. This was the first meeting of the Association since 1942. Dr. Mary Stuart MacDougall, Agnes Scott College, is president of the Association, and Martin D. Young is secretary-treasurer.

The National Analysts, Inc., of Philadelphia, a complete marketing and research organization, announces the opening of its Washington Branch under the direction of Mrs. W. Charlotte Ewell, 203-A Stoneleigh Court, 1025 Connecticut Avenue, N. W.

The American Society for Horticultural Science announces the award of the Leonard H. Vaughan Memorial Award in Horticulture to Dr. V. T. Stoutemyer, U. S. Plant Introduction Garden, Glenn Dale, Maryland, for his paper on "The influence of changes in molecular configurations of several naphthyl growth substances on the rooting responses of cuttings" (*Proc. Amer. Soc. hort. Sci.,* Vol. 44), and to Dr. P. W. Zimmerman and Dr. A. E. Hitchcock, of the Boyce Thompson Institute for Plant Research, for their paper, "Substances effective for increasing fruit set and inducing seedless tomatoes" (*Proc. Amer. Soc. hort. Sci.,* Vol. 45).

This award is made each year through the generosity of the Vaughan Seed Stores of Chicago, Illinois, in memory of Leonard H. Vaughan. One award is made in floriculture and one in vegetable gardening, each for $500.

Clinical and research activities of the Clinic of Child Development, School of Medicine, Yale University, were depicted in a documentary film, the January issue of *The March of Time.* The film pictures a wide range of infants and preschool children, and is sound scored with dialogue and commentary.

Hitherto secret methods of flying training, employed by the RAF to meet a wartime emergency, proved so successful that they are being adopted as standard throughout the RAF and Dominion Air Forces. The methods were demonstrated at the Empire Central Flying School at Hullavington, Wiltshire, on 20 March, according to *The Times,* London.

The problem of night-flying training was solved by developing a combination of light-absorption filters which isolate the wave lengths of sodium light, which thus remains visible through otherwise dark filters.

The use of these filters has been developed in two ways to meet different requirements. To gain experience of "night" landing in daylight the pupil pilot wears filter goggles through which he can see nothing but the sodium flarepath on the airfield and the aircraft instruments, which are also sodium-lit. The

instructor, sitting at his side without goggles, can, of course, see everything clearly. For training in instrument flying what is known as the two-way method is employed. Simple complementary color filters of blue and amber cut off the light in two stages. The windows of the cockpit are covered with the amber filter and the pupil-pilot wears blue goggles. The instructor has almost normal daylight vision through the amber windows, but the pilot can see only the sodium-lit instruments.

In both these methods of training the degree of "darkness" can be varied by the intensity of the filter used, so as to simulate conditions ranging from dusk to starlight, bright moonlight, and a very dark night.

The Radiolocation Convention, held at the Institution of Electrical Engineers, Savoy Place, London, 26–28 March, had an attendance of approximately 1,000. An attempt was made to review the developments in the field of radiolocation during the last six years. Those invited include delegations from eight other countries—Canada, the United States, France, Russia, Poland, Norway, Holland, and Switzerland.

The convention was opened by John Wilmot, Minister of Supply and Aircraft Production, P. Dunsheath, president of the Institution of Electrical Engineers, presiding.

Mr. Wilmot said he thought that only one other wartime development, penicillin, had as many possibilities for benefiting humanity as radar.

The opening session was also addressed by F. B. Llewellyn, president of the Institute of Radio Engineers of America, who said it was possible that radar was the best example of cooperative technical effort that the world has ever known. As radar had served during the war, so it could also serve during the peace.

Sir Robert Watson-Watt, speaking on the British contribution to the evolution of radiolocation, said it would be foolish to claim priority in the inception of radar for either Britain or America. The work done before the autumn of 1940 was completely independent in the two countries, while the work done thereafter was completely interdependent.

Every radar-equipped combat aircraft, ship, gun, and searchlight was, after every offsetting factor had been allowed for, much more than doubled in effectiveness by its radar aids.—*The Times* (London).

Southern Methodist University has announced a gift of $1,000,000 from Mrs. W. W. Fondren of Houston, Texas, for the construction of a building for the natural sciences. The Fondren School of Science will be housed in the building, which will include the Departments of Physics, Biology, Chemistry, Geology, and Geography.

The American Anthropological Association, at its annual meeting on 28 December adopted the following resolutions:

1. That the appropriate United States authorities be apprised of the strong opinion of the American Anthropological Association that scientific documents and specimens and works of art, legitimately acquired in the first instance by public institutions in enemy countries, be not made subject to seizure or to alienation by the United States as reparations and that as soon as possible such materials be restored to the institutions originally housing them.

2. That the American Anthropological Association, constituted of scientists interested in the study of human nature and society, recognizes the responsibility of anthropologists to study the effects of the discovery of the use of atomic energy, and to participate actively with other scientists in efforts to make appropriate social inventions to guard against the dangers and utilize the promise inherent in atomic use.

Dr. Frederick V. Hunt, associate professor of physics and communication engineering, who was director of Harvard's Underwater Sound Laboratory during the war, has been named chairman of a new department, Engineering Sciences and Applied Physics.

Several faculty groups now giving instruction in electronics, communication engineering, applied mathematics, acoustics, metallurgy, and mechanical engineering will be merged as a nucleus for the new department, which has been allotted $2,000,000 from the McKay Endowment.

Insect pests develop relative immunity to poisons by evolving new strains, presumably through normal processes of evolution. This is one of the chief reasons why the codling moth has remained a pest of apple orchards throughout the United States for more than a century, according to Dr. B. A. Porter, of the Department of Agriculture, in a report just issued by the Smithsonian Institution.

This insect is familiar everywhere. About 40 investigators, employees of federal and state governments, devote their entire time to studying means of combating it. The chief means used is that of spraying trees with lead arsenate. Yet it seems impossible to eliminate the pest, and from year to year it seems about as abundant as ever.

Recent experiments have shown, Dr. Porter says, that moth larvae from well-sprayed orchards show much greater ability to survive lead arsenate than those from poorly sprayed orchards, indicating the phenomenon of evolution in the survival of the fittest.

"The evidence indicates," he continues, "that, instead of remaining constant and static while the evolution

of control measures was going on, the codling moth as a species has undergone considerable adaptation or evolution on its own account in the direction of greater ability to survive in the presence of insecticides. The segregation of resistant strains, together with certain practices on the part of the fruit industry, have permitted the insect to maintain its position as the most seriously destructive pest of the apple, in spite of the development of control by insecticides to a high degree of efficiency.

"The codling moth is only one of several insect pests known to have undergone development in this general direction, and many other insects may be developing in a similar way but at a slower rate."

The active participation of all botanists in the Southeast was made the goal of the Southeastern Section of the Botanical Society of America at a luncheon meeting of the section on 28 March in St. Louis, attended by members and visitors representing 13 institutions and 7 states in the area. The section chairman, Orland White, presided, and S. L. Meyer acted as secretary in the absence of Dr. Hunt; John Karling, secretary of the Botanical Society, was a visitor. New officers were chosen, who will determine the time and place for a spring or summer meeting of the Southeastern Section. They are L. R. Hesler, University of Tennessee, chairman; John N. Couch, University of North Carolina, secretary; and Velma Matthews, Coker College, Hartsville, South Carolina, and Ruth Schornherst, Florida State College for Women, Tallahassee, members of the Activities Committee.

A committee of three members of the American Association of Physics Teachers has been formed to assist in the improvement of the teaching of physics to premedical students and students of biology, following a recommendation from the Scientific Advisory Committee of the Baruch Committee on Physical Medicine.

The efforts of the committee are to be directed along two lines: (1) to assemble and make available to teachers of the first course in college physics illustrative material from biology and medicine which will show physical principles at work in biological processes and physical principles applied in the study of biological processes; (2) the planning of a second course in physics for students of biology and premedical students.

The committee requests those biologists, physicists, and physicians interested in this project who have suggestions for content to correspond directly with LeRoy L. Barnes, Rockefeller Hall, Ithaca, New York, chairman. Other members of the committee are Lester I. Bockstahler and Louis A. Strait.

A project in internal medicine at the New York Hospital has been announced by Cornell University. Designed to deal clinically and experimentally with psychosomatics, the project has three main objectives: (1) to develop a practical method for dealing with ambulatory clinic patients who suffer from symptoms related to their emotional states and life situations; (2) to engage in experimental study of the mechanisms involved in illness of this nature; and (3) to train especially able young physicians in experimental methods and to develop a critical psychosomatic approach to the care of the sick. Approximately half of the time will be spent in the diagnosis and management of patients, and the remainder in research dealing mainly with mechanisms underlying symptoms.

The project will be directed by Dr. Harold G. Wolff, with the assistance of an internist, Dr. Stewart Wolf; a psychiatrist, Dr. Herbert S. Ripley, Jr.; and six fellows. Fellows will be appointed for a period of one year with the expectation of serving for two or more. Their salary for the first year will be $2,500. Candidates for fellowships should have at least two years training in internal medicine and give evidence of a psychiatric orientation. They need not have had experience in research but must have a serious interest in investigation, energy, and curiosity.

Prospective candidates should arrange for a personal interview through Dr. David P. Barr, Professor of Medicine, The New York Hospital, 525 East 68th Street, New York City.

The Hematology Research Foundation, Chicago, invites applications for the Ruth Reader Fellowship for research in blood diseases. The value of this fellowship is $1,500 for one year. Applications must be submitted no later than 1 June to Dr. Ludwig Hektoen, 21 West Elm Street, Chicago, the chairman of the Medical Advisory Council for the Foundation. The Council will choose the applicant and the institution in Chicago.

Meetings

The American Association of Physics Teachers, in cooperation with the Society for the Promotion of Engineering Education, will hold a meeting at St. Louis, Missouri, 20–22 June 1946. Headquarters for this meeting and its sessions will be the Jefferson Hotel, and members are advised to make room reservations as soon as possible. The program for this meeting will be mailed to all AAPT members shortly after the deadline date for abstracts, 10 May 1946. C. J. Overbeck, of the Physics Department, Northwestern University, Evanston, Illinois, is the secretary.

The Society for Applied Spectroscopy is sponsoring a meeting on the subject of spectroscopic nomenclature to be held Saturday, 11 May, at the Pennsylvania Hotel in New York. Duane Roller, of Wabash College, editor of the *American Journal of Physics,* will discuss physics nomenclature in general; B. F. Scribner, of the National Bureau of Standards, will discuss nomenclature for emission spectroscopy; and a speaker to be announced will discuss nomenclature for absorption spectroscopy at the morning session beginning at 9:30.

The afternoon meeting will be devoted to general group discussions of specific proposals presented by special committees of the Society. There will be separate sessions for those interested in emission and in absorption. It is hoped that the final result of the meeting will be the adoption of a definitive nomenclature for all branches of spectroscopy.

The New England Section of the American Society of Plant Physiologists will resume its schedule of annual meetings on 17–18 May at Harvard University. Dr. Kenneth V. Thimann, Harvard University, is chairman, and Dr. Linus H. Jones, Massachusetts State College, is secretary. The meeting will be held in the Harvard Biological Laboratories beginning on the afternoon of 17 May and is open to all interested in the subject of plant physiology.

Elections

Prof. Sidney Chapman, Imperial College of Science and Technology, London, and Peter Leonidovich Kapitza, director of the Institute for Physical Problems of the Academy of Sciences, Moscow, were elected foreign associates of the National Academy of Sciences, which held its annual meeting 22–24 April in Washington, D. C.

Detlev W. Bronk, director of the Johnson Research Foundation, University of Pennsylvania, was elected foreign secretary, while I. I. Rabi, professor of physics, Columbia University, and Walter R. Miles, professor of psychology, Yale University School of Medicine and chairman of the Division of Anthropology and Psychology of the National Research Council, were elected to the Council of the Academy.

Twenty-nine new members were also elected: Samuel King Allison, director, Institute for Nuclear Studies, University of Chicago; Rudolph John Anderson, professor of chemistry, Yale University; Ernest Brown Babcock, professor of genetics, University of California, Berkeley; Kenneth T. Bainbridge, associate professor of physics, Harvard University; Elmer K. Bolton, director, Chemical Department, E. I. duPont de Nemours and Company, Wilmington, Delaware; Wilmot Hyde Bradley, chief geologist, U. S. Geological Survey, Washington; Perry Byerly, professor of seismology, University of California, Berkeley; Paul Roberts Cannon, professor of pathology, University of Chicago; Milislav Demerec, director, Department of Genetics, Carnegie Institution of Washington; Jesse Douglas, associate professor of mathematics, Brooklyn College; Clarence Henry Graham, professor of psychology, Columbia University; Morris S. Kharasch, Carl William Eisendrath Professor of Chemistry, University of Chicago; Karl Paul Link, assistant professor of biochemistry, University of Wisconsin; Robert F. Losh, Lambert Professor of Medicine, College of Physicians and Surgeons, Columbia University; Esmond Ray Long, professor of pathology, School of Medicine, and director of laboratories, Henry Phipps Institute, University of Pennsylvania; Joseph E. Mayer, professor of chemistry, Columbia University; Charles Snowden Pigget, physical chemist, Geophysical Laboratory, Carnegie Institution of Washington; Marcus Morton Rhoades, professor of botany, Columbia University; George Scatchard, professor of chemistry, Massachusetts Institute of Technology; Tracy Morton Sonneborn, professor of zoology, Indiana University; Leslie Spier, professor of anthropology, University of New Mexico; Stanley Smith Stevens, associate professor of psychology, Harvard University; Chauncey Guy Suits, director of research laboratory, General Electric Company, Schenectady; Frederick E. Terman, head of Department of Electric Engineering, Stanford University; Merle Antony Tuve, chief physicist, Carnegie Institution of Washington; Chester Hamlin Workman, head of Department of Bacteriology, Iowa State College; Roger John Williams, director of Biochemical Institute, University of Texas; Frank Clifford Whitmore, dean, School of Chemistry and Physics, Pennsylvania State College; and Wendell Phillips Woodring, principal geologist, U. S. Geological Survey, Washington.

The American Association of Pathologists and Bacteriologists elected the following officers for 1946 at its annual meeting in Chicago on 8 March: Wiley D. Forbus, Durham, North Carolina, president; Malcolm H. Soule, Ann Arbor, Michigan, vice-president; Howard T. Karsner, Cleveland, secretary; Alan R. Moritz, Boston, treasurer; Tracy B. Mallory, Boston, incoming member of Council; and William B. Wartman, Cleveland, assistant secretary.

The American Ethnological Society announces the election on 8 January of the following officers for the year 1946–47: Hortense Powdermaker, Queens College, president; E. Adamson Hoebel, New York University, vice-president; Sherwood L. Washburn, Columbia University, vice-president; Esther S. Goldfrank, Columbia University, secretary-treasurer; Marian W. Smith, Co-

bia University, editor; and Gladys A. Reichard, rnard College, Harry L. Shapiro, American Mu- m of Natural History, and Carl Withers, Brooklyn llege, directors.

The American Institute of Nutrition, at a recent eting in Atlantic City, elected the following officers r 1946–1947: A. H. Smith, president; R. M. Bethke, e-president; and H. J. Almquist, councillor. H. E. rter and E. M. Nelson continue as secretary and as easurer, respectively, and C. A. Elvehjem and D. W. oolley continue on the Council.

The Louisiana Academy of Sciences has elected the llowing officers for 1946–1947: Alvin Good, North- estern State College, Natchitoches, Louisiana, presi- ent; John L. Hardin, Centenary College, Shreveport, ice-president; Lauretta E. Fox, Northwestern State ollege, Natchitoches, chairman of the Biological Sci- nces Section; H. C. Eshelman, Southwestern Louisi- na Institute, Lafayette, chairman of the Physical Sciences Section; Roy E. Hyde, Louisiana State Uni- versity, Baton Rouge, chairman of the Social Sciences Section; George H. Lowery, Louisiana State Univer- ity, Baton Rouge, editor; E. A. Fieger, Louisiana State University, Baton Rouge, permanent secretary; and H. Bruce Boudreaux, Louisiana State University, Baton Rouge, secretary-treasurer.

The Limnological Society of America elected the following officers at its recent annual meeting: Paul S. Welch, University of Michigan, president; A. D. Hasler, University of Wisconsin, vice-president; G. L. Clarke, Harvard University and the Woods Hole Oceanographic Institution, secretary-treasurer. All business communications in regard to the Limnological Society should henceforth be addressed to the latter.

The American Society of Plant Taxonomists has elected the following new officers: Philip A. Munz, president; E. E. Sherff, chairman of the Council; and Lincoln Constance, secretary-treasurer.

The American Society for Pharmacology and Experimental Therapeutics held its 34th annual meeting in Atlantic City on 11–15 March 1946. The following officers were elected: Maurice H. Seevers, University of Michigan, president; H. B. van Dyke, Columbia University, vice-president; Harvey B. Haag, Medical College of Virginia, secretary; McKeen Cattell, Cornell University, treasurer. Hamilton H. Anderson, University of California, and Dr. John C. Krantz, Jr., University of Maryland, were elected councilors.

The Branner Geological Club held its annual meeting on 15 March at the California Institute of Technology in Pasadena. Since this was the 25th anniversary of the Club, Dr. Ralph Arnold, a charter member and the first president, told of the formation of the Club and reviewed the life of Dr. John Casper Branner.

New officers elected at this meeting for 1946 are: W. C. Putnam, University of California at Los Angeles, president; W. T. Winham, Standard Oil Company of California, vice-president; Richard Ten Eyck, Continental Oil Company, secretary-treasurer.

Dr. Chester Stock spoke briefly on the Pittsburgh meetings of the Geological Society of America, and Dr. Beno Gutenberg spoke on the earthquake shocks that had been felt during the morning. The principal address was given by Dr. R. Dana Russell, of the University of California Division of War Research at San Diego, on "Geologists and Sonar."

The Association of American State Geologists, which usually meets in Washington, D. C., this year held its annual meeting at Urbana, Illinois, upon invitation of M. M. Leighton, chief of the Illinois Geological Survey. Inspection of the laboratories of the Survey and descriptive papers of the investigations being conducted in them by members of the staff were outstanding features of the three days spent at Urbana. The meetings drew members from all sections of the United States. Addresses were made by W. E. Wrather, director of the U. S. Geological Survey; E. W. Pehrson, representing the U. S. Bureau of Mines; Bruce K. Brown, vice-president of the Standard Oil Company (Indiana); and others. The following new officers were elected: Meredith E. Johnson, of New Jersey, president; A. C. Trowbridge, of Iowa, vice-president; and Edward L. Troxell, of Connecticut, secretary-editor.

The Department of Plant Sciences of the University of Oklahoma has elected Dr. Howard W. Larsh as chairman. It has also recently added the following members to its staff: Dr. George J. Goodman, professor and curator of the Bebb Herbarium; Dr. Norman H. Boke, assistant professor; Dr. Dorothy V. Leake and Dr. Elwyn O. Hughes, instructors; Mr. Robert H. Rucker, landscape architect; Mr. Frank Rinehart, custodian; Miss Marylou Stiemert, Miss Phyllis Thompson, Mr. Tillman Johnson, and Mr. Vernon Scott, assistants; and Mrs. Jean Moore, secretary.

The Union of American Biological Sciences elected the following officers at its recent annual meeting in St. Louis: Robert Chambers, New York University, president; J. S. Karling, Columbia University, secretary; and Frank A. Brown, Jr., Northwestern University; M. Demerec, Carnegie Institution; and Robert F. Griggs, National Research Council, Executive Committee members.

The American Physiological Society has elected the following officers for 1946: Wallace O. Fenn, president; Maurice B. Visscher, secretary; D. B. Dill, treasurer; and Henry C. Bazett, councilor.

Recent Deaths

Jean-Marie-Eugène Derscheid, ornithologist and conservationist, was imprisoned by the Germans in 1941 and executed on 13 March 1944. He had made several trips to the Congo, one of them with the American expedition for studying gorillas, which were headed Carl Akeley. Dr. Derscheid was the principal p moter of Réserves Naturelles in the Belgian Congo effected establishment of Le Parc National Albert, which he was made director. He was an enthusia aviculturist, studying in particular the Anatidae, a he was the artist who designed the fine Gyrfalcon the cover of *Le Gerfaut.* In this journal (1945, 3 109–111) Charles Dupond gives an account of D Derscheid's contributions to science and conserv tion.—*Margaret M. Nice* (Chicago, Illinois).

In the Laboratory

Nucleosis of Skeletal Muscle: Its Value as a Biological Test[1]

RUDOLF ALTSCHUL

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Damage to skeletal muscle which is not severe enough to cause necrosis provokes not only alterations in the sarcoplasma but intense proliferation of subsarcolemmal nuclei (nucleosis). Such damage may be caused by mechanical or toxic agents, by ischemia or avitaminosis-E; its nature may be unknown, as in either progressive muscular dystrophy or in denervation. The nuclear proliferation is frequently so active that the nuclei fill the sarcolemma producing the "nuclear tubes" of Waldeyer. If nucleosis occurs only in restricted zones of the fiber, it results in "muscle giant cells" or in "fiber clubs."

This proliferation may be interpreted as regenerative or as reactive in nature. It may, however, constitute the initial stage of a metaplasia of skeletal muscle into connective tissue. There is no agreement as to the manner in which the numerical increase of muscle nuclei occurs. While some authors believe that the proliferation is due to mitosis (A. M. Pappenheimer, *3*; Chor, Dolkart, and Davenport, *2*), others regard the process as "amitotic" (Tower, *4*; Altschul, *1*). Whether amitosis occurs at all, whether it is the division of damaged cells, or whether it is limited to syncytia are questions that are still under discussion. A solution of this problem regarding skeletal muscle would not only have a theoretical interest but might explain certain features in muscle degeneration and lead to an improvement of measures for the preve tion of muscle degeneration.

If mitosis of subsarcolemmal nuclei does occur i denervated or otherwise damaged muscle, it shou be easy to find mitotic figures amongst the gre number of recently proliferated nuclei. The writ has examined several hundred sections showing nuclea proliferation in muscle fibers but has been unable t find clear evidence of mitosis; yet there have bee many indications of amitosis, in the form of constri tions and, even more frequently, of fissures. The latter were especially clear if the sections were staine with cresyl violet instead of the standard hematox lin-eosin.

Since the apparent lack of mitotic figures and th presence of morphological changes, suggesting amito sis, are insufficient to justify a final decision on th nature of this nuclear proliferation, an attempt ha been made to obtain more conclusive evidence by th use of colchicine. The procedure and preliminary findings were as follows: The skeletal muscles of rab bits, guinea pigs, and white rats were denervated o locally injured by the insertion of catgut or cotton threads. Three months after denervation nucleosis and other histological changes are very pronounced. Subcutaneous injections of 0.2–0.3 mg. of colchicine per 100 grams of body weight, 4 or 9 hours before the animal was killed, failed to arrest a hypothetical mitosis, and the "colchicine effect," with its apparent or real numerical increase of mitotic figures, was lacking. The decomposition of proliferated nuclei was more pronounced than in control cases.

Focal injury by threads permits one to observe and analyze the degree of muscle damage and of tissue reactions. It is found in cross-sections that the dif-

[1] Supported by a grant from the National Research Council of Canada, Associate Committee on Army Medical Research.

nt pathological changes are arranged concentri-
ly. In the center is the thread or the space through
ich it passed, surrounded or filled by necrotic
ses. Next are reactive and reparative processes
inflammatory type, then hyaline muscle fibers,
outside these an occasional layer of calcified (pre-
usly hyalinized?) muscle fibers. Still further out
"muscle giant cells" or fiber clubs with prolifer-
d nuclei, then thin muscle fibers with less marked
cleosis, and finally, normal muscle with some inter-
tial reaction. As may be expected, there is often
me overlapping of these zones. If the injury and
ctions are slighter, the hyalinization, calcification,
d nuclear proliferation in the muscle fibers may
absent.

Following these injuries the effects of colchicine and
er substances may be determined. If, after local
jury to muscle, colchicine is given in repeated doses
er a 5- to 10-day period, nucleosis will be slight or
tirely absent. But if a single dose is administered
to 10 days after the injury and the animal killed
to 9 hours later, nucleosis will be present. In
ither case have any mitotic figures been found.
odium cacodylate is reputed to have an action simi-
to colchicine. Its use in these tests failed to bring
t mitotic figures in the damaged muscle or to in-
ence nucleosis, though enlargement of many nuclei
curred. When quinine sulphate or quinine chloride
s given to animals with local injuries of skeletal
uscle, an increased nucleosis was observed. X-ray
radiation of locally injured muscle had so far no
fluence on nucleosis.

In carrying out the experiments with colchicine,
odium cacodylate, and quinine, it was found desir-
ble to bring these substances into more intimate con-
act with the tissue, showing nuclear proliferation.
Prior to insertion, the threads were impregnated with
he test substance which was used in aqueous or
queous-gelatinous solution.

The above-described procedure by which muscle
tissue is injured locally and acted upon more or less
ontemporaneously (a) through the general circula-
ion, by introducing drugs either orally or hypoder-
mically, (b) locally, by impregnating the introduced
hreads with the drug, and finally (c) by the combina-
ion of (a) and (b), should prove helpful as a bio-
logical test to ascertain the influence of certain sub-
tances on pathological processes in skeletal muscle.

Addendum: Since this paper was submitted for pub-
lication, W. E. Le Gros Clark has published an article
(*J. Anat.*, 1946, **80**, 24) in which he describes the use
of colchicine for ascertaining the lack of mitotic divi-
ion in injured skeletal muscle. No mention is made
of the influence of the drug on amitotic proliferation.

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On the Fluorometric Determination of Nicotinamide[1]

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After Najjar's detection (*8*) of F_2, a metabolite of nicotinamide, fluorometric methods for its determination were developed (*2, 6*). Although F_2 is measured fluorometrically, investigators are still obliged to measure concentrations of nicotinamide colorimetrically. A simple means of measuring both substances fluorometrically is, therefore, desirable.

When it was shown that F_2 is an N-methyl-β-formamidopyridinium salt (*3, 4, 7*), it became evident that the fluorometric methods for the determination of F_2 can be used for nicotinamide if the latter substance can be converted to F_2. N-methylation of nicotinamide was carried out (*5*) under reflux conditions for six hours with excess methyl iodide. It has now been found that this reaction can be effected more simply by allowing dilute methanolic solutions to stand overnight at room temperatures in the presence of excess methyl iodide. The excess methyl iodide is readily removed by evaporation under a current of air. The product, treated with alkali and isobutanol, may then be measured fluorometrically according to the method described by Najjar (*6*). Thus, given a solution of nicotinamide and N-methyl-nicotinamide chloride, the metabolite is measured as usual, and after treatment with methyl iodide, a second analysis gives the sum of the metabolite and the nicotinamide.

In the course of this work, which has since been discontinued, a simpler and more rapid method for the fluorometric measurement of nicotinamide was found. The method involves treatment of aqueous solutions of nicotinamide with cyanogen bromide according to Bandier and Hald's colorimetric method (*1*). Instead of adding the metol solution to complete the color reaction, alkali is added; the product is extracted with isobutanol, and readings are taken fluorometrically as described by Najjar (*6*). Unlike pyridoxal, the pyrimidine moiety of thiamine and certain alkaloids, the following do not interfere: pyridine, nicotinic acid, methyl nicotinate, pyridoxine, and pyridoxamine. When the test is performed as described,

[1] Thanks are due Mr. J. C. Hornberger for his assistance.

[2] Affiliated with Merck and Company, Rahway, New Jersey, when this article was prepared.

nicotinamide gives rise to a greater fluorescence intensity than an equivalent weight of N-methyl-nicotinamide chloride. This unexpected increment is quite pronounced, and, as a result, one may measure as little as one microgram of nicotinamide. The fluorescence is stable, and measurements are reproducible. The method appears to be simpler, more sensitive, and more reproducible than existing colorimetric methods.

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Chloride-free Filter Paper

Daniel Cushing, *Boston, Massachusetts,* and Ralph N. Prince and Joseph Seiberlich, *Engineering Experiment Station, University of New Hampshire, Durham*

In recent years considerable emphasis has been placed on the purity of reagent chemicals—so much, in fact, that manufacturers have found it necessary to include the analysis on the labels. Nevertheless, no restrictions upon the purity of the filtering media used in analytical work have been mentioned in laboratory procedures. Small quantities of impurities have little significance in macroanalytical work, but become proportionately serious when microanalytical procedures are used.

Benedetti-Pichler (*1*) has recommended Schleicher and Schuell filter papers No. 589 (black or blue ribbon) and No. 601 (spot test paper) in the experiments which he has outlined. In no instance has he indicated the degree of chemical purity of the above papers, although it is stated that "as a rule, the efficiency of the tests is greatly affected by the type of paper used." In an earlier work the above author and Spikes (*2*) have referred the reader to the silver test of the caution group in a discussion of the identification of the chloride ion. No caution concerning possible contamination by the filtering medium was mentioned. Chamot and Mason (*3*) in their descriptions of filtering methods for chemical microscopy, have not indicated that the filtering medium must be of any particular quality. It may be that the false concept that filter paper is pure cellulose still persists.

The recent Federal specifications (*6*) for filtering paper have not mentioned the chemical purity of the product; however, by private communication it has been found that they refer to the usual analytical operations and that no consideration was given to special tests such as might be required in biological or microanalytical work.

There are some analyses in the biological and metallurgical fields where the presence of certain ions, particularly chloride ion, in the filter paper could lead to false conclusions. An example of ion interference in metallurgical work is that of the chloride ion in corrosion studies. Here microanalytical filtering technique is employed together with microscopical identification methods. In studying the corrosion of metals, particularly that of stainless steel, the test for chloride ion is very important. Filter paper is often necessary when analyzing the minute quantities of films and deposits by the various techniques of chemical microscopy. Inasmuch as such corrosion studies call for definite negative results as well as uncontaminated positive results, it can be seen readily that traces of chloride ion would introduce serious interference.

If a circle of a commercial filter paper is shaken with redistilled water until it is well pulped, the fact that chloride is present can be easily confirmed. When the water is removed by decantation or centrifuging and tested for chloride ion, a positive result will be obtained.

Proper and Green (*4*) have stated that a hypochlorite bleaching is usually used in the preparation of pulp for filter paper, and that all of the bleach must be removed with pure water. W. Schmid (*5*) has indicated that chlorine gas as well as hypochlorite is used in the manufacture of high-grade Swedish filter papers, and that thorough washing must be done to remove the chlorides. Nevertheless, chloride ion has been found in all of the papers tested.

Since chloride-free filter papers are not available commercially, a method for obtaining these has been worked out. The demand for a filter paper of this type would normally be rather small, and, since it would not be practicable to store much material for long periods of time, the method has been so arranged that any chemist can prepare his own filter paper as required.

The Federal specifications have called for 100 per cent rags as raw material. But, the history of the rags being unknown, it would be quite possible for traces of chloride to be present from previous bleaching operations. Therefore, unbleached sulfite wood pulp was chosen as the raw material.

The pulp was bleached with sodium peroxide, although any bleaching agent which contained no chlorine could have been used. First, 5 per cent sodium peroxide, based on the pulp weight, was dis-

olved in water and then thoroughly mixed with the pulp at approximately 10 per cent consistency. The reaction was allowed to proceed overnight at room temperature, after which the temperature was raised to 50° C. for an hour. The spent liquor was drawn off, and a second treatment with sodium peroxide of the same strength was carried out for an hour at 50° C. Inasmuch as the unbleached sulfite pulp was not iron free, the bleached pulp was steeped for 15 minutes in a 1-per cent oxalic acid solution in order to remove the iron. It was then washed free of oxalates with distilled water, since tap water usually contains chlorine. A filter paper made from a pulp thus treated was chloride free, but its ash content corresponded to that of qualitative paper.

Reduction of the mineral content of the pulp without introducing chloride could be accomplished in several ways. Such acids as sulfuric, phosphoric, and oxalic, or mixtures of them in various strengths, could be used. In the present work, the pulp was mixed with a sufficient quantity of 10 per cent orthophosphoric acid to result in a consistency of about 5 per cent. It was heated to 50° C. for 15 minutes, the acid was filtered off, and the filter cake was washed free of phosphates.

In commercial preparation, it could be expected that traces of phosphate ion might remain in the pulp even though it was thoroughly washed. Therefore, when microdeterminations are made for phosphate ion, it would be best to use a standard filter paper from which the ash has been removed by hydrochloric acid. Pulp treated thus had an ash content comparable to that of commercial quantitative filter papers.

A high-speed laboratory stirrer was used to break up the pulp at a consistency of 1 to 2 per cent, after which it was thickened to the desired degree for bleaching. The purified pulp was dispersed in a similar manner in distilled water at about 0.5 to 1 per cent consistency. The filter paper was formed on a finely woven, cotton fabric which had been placed over the holes of a Buchner funnel of the size desired. The sheet was formed while the water was removed slowly by reducing the pressure slightly in the filter flask. When the water had been removed, full suction was applied. Then the sheet was wet with alcohol (chloride free) to harden it. The sheet was transferred to a glass plate, pressed, and then dried.

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Letters to the Editor

Science and Mankind's Plight

In his recent address at the AAAS meeting in St. Louis (*Science*, 1946, 103, 337), Dr. A. J. Carlson clearly depicts the dilemma mankind is in about the state of human affairs.

Dr. Carlson sees a helplessness in every direction that has us puzzled, much as a doctor who gazes baffled at a person very sick with some disease he does not understand. All leading scientists who have given thought to the world's troubles feel about them as he does.

This was very frankly admitted by Wesley C. Mitchell, then of Columbia University, in his striking address as president of the AAAS at the annual meeting of the Association in Columbus, Ohio, in December 1939, when with other things he noted:

"If we can come to a clearer understanding of how we behave, perhaps, and perhaps is all we can say, we can learn how to condition men so that their energies will go less into making one another miserable. . . .

"The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not only does no individual have more than a tiny fraction of the knowledge that is needed; all scientists of the country put together do not know enough to solve many of the problems that a democracy faces."

Since Dr. Mitchell's address, great changes for the worse have come over the world, and the darkness now is much darker than at the time he expressed those views. The baffling problem now is to know how science can break through this darkness to save mankind, for only science can do that.

Dr. Carlson sees hope for betterment if the integrity ruling in science can be injected into the common life of the people. He now sees dishonesty, guile, deceit, and the Golden Rule in reverse, which is only too true, pervading and governing so much that is going on in the Nation and the world.

Since the desire for money is mainly the cause of this, it being regarded as an end rather than the means, which it really is, perhaps the social evils and human deterioration caused by money being so regarded will pass away when money ceases to be the power it now is.

In the coming atomic age nuclear energy will be the driving power of the social order.

The foregoing are not the views of a scientist; they are those of a layman who has taken a keen interest in certain branches of science for many years. Though he has worked as a machinist in a war plant until recently, and spent his life prior to that in the mines in South Wales and America as a miner, he has reflected a good deal on some of the major problems of life.

G. EDGAR OWEN
Harris Building, Honesdale, Pennsylvania

The Atomic Bomb and the Anthropologists

In his admirable address, "Science and Our Future" (*Science*, 1946, **103**, 415–417), Dr. E. U. Condon very properly criticizes the viewpoint of anthropologists who "fatalistically await death, reading papers to an academic society meeting in a museum in Philadelphia." I think it should be placed on record that almost all the anthropologists present at that meeting rejected that viewpoint, and that upon my moving and Dr. Margaret Mead seconding, the following resolution was unanimously adopted by the American Anthropological Association:

RESOLVED: That the American Anthropological Association, constituted of scientists interested in the study of human nature and society, recognizes the responsibility of anthropologists to study the effects of the discovery of the use of atomic energy, and to participate actively with other scientists in efforts to make appropriate social inventions to guard against the dangers, and utilize the promise, inherent in atomic use.

M. F. ASHLEY MONTAGU
Hahnemann Medical College, Philadelphia

Pathogenesis of Kernicterus

The purpose of this communication is to present our concept of the pathogenesis of kernicterus (jaundice of the nuclear masses of the brain), based on recent clinical, serological, and pathological observations. Until recently there was no explanation for the post-mortem finding of kernicterus only in cases of icterus gravis neonatorum (a form of congenital hemolytic disease or erythroblastosis) and not following other types of jaundice, even of severe degree.

As is well known, the great majority of cases of congenital hemolytic disease occur when an Rh– mother, already sensitized to the Rh factor by a previous pregnancy or transfusion, bears an Rh+ fetus. The antibodies in the sensitized mother's serum may be of two principal varieties, namely, bivalent antibodies (agglutinins) and/or univalent antibodies (glutinins or blockers). If the maternal serum contains a high titer of univalent antibodies, the Rh+ fetus will almost surely be stillborn. With low-titered univalent antibodies, viable infants who recover after suitable transfusion therapy are the rule.

In our experience, when the complication of kernicterus supervenes, the antibodies in the maternal serum are almost always of the bivalent variety (agglutinins). This suggests the following mechanism for the development of kernicterus. Maternal Rh agglutinins in the infant's circulation combine with its Rh+ erythrocytes, bringing about the formation of small clumps (agglutinates of red cells) which plug the smaller arterioles with the formation of agglutination thrombi. In an organ like the liver, the resulting damage may be one factor in the production of jaundice, thus explaining its lack of correlation with the degree of anemia. In the bone-marrow, the resulting irritation may cause a pouring forth of nucleated red cells into the circulation. In the brain, plugging of terminal vessels can produce areas of ischemic infarcts; the nuclear masses would be most vulnerable, since ganglion cells are particularly susceptible to anoxia. Due to the concomitant presence of deep jaundice, the damaged ganglion cells take up bilirubin—a sort of *in vivo* staining reaction. If the infant dies at this point, post-mortem examination will show the presence of kernicterus. Infants surviving the immediate neonatal period and dying after the jaundice has disappeared will show at post-mortem examination evidence of cerebral damage but without kernicterus. In a recent case studied by us, where death occurred 48 hours after birth, in addition to the post-mortem finding of kernicterus, histologic study showed the blood vessels of the brain to be packed full by agglutinated masses of erythrocytes, as required by our theory.

Infants with kernicterus occasionally survive, in which case they develop signs of a diffuse neurologic disorder of varying severity, usually accompanied by mental deficiency. Such cases are rare and would be expected to make up only a very small fraction of the group of so-called nonspecific mental deficiency cases. Therefore it could be predicted a priori that attempts such as have recently been made to show a statistical difference in the distribution of the Rh factor among mothers of mentally deficient children in comparison with the normal population would almost surely yield insignificant results unless the series is large enough to detect a small percentage difference.

Attempts have been made to show a connection between Wilson's disease and kernicterus. In three cases of Wilson's disease studied by us we found no evidence of isoimmunization of pregnancy, indicating a dissimilarity in the pathogenesis of the two conditions.

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MATTHEW BRODY
Department of Neurology, Brooklyn Jewish Hospital

Genetics and Biological Theory

E. B. Wilson, in his classical work (*The cell in development and heredity*. New York: Macmillan, 1928), states: "In practice all purposes of experimental analysis are sufficiently met if the hereditary 'units,' 'genes' or 'pangens' be thought of merely as modifiers which call forth responses, this way or that, according to their

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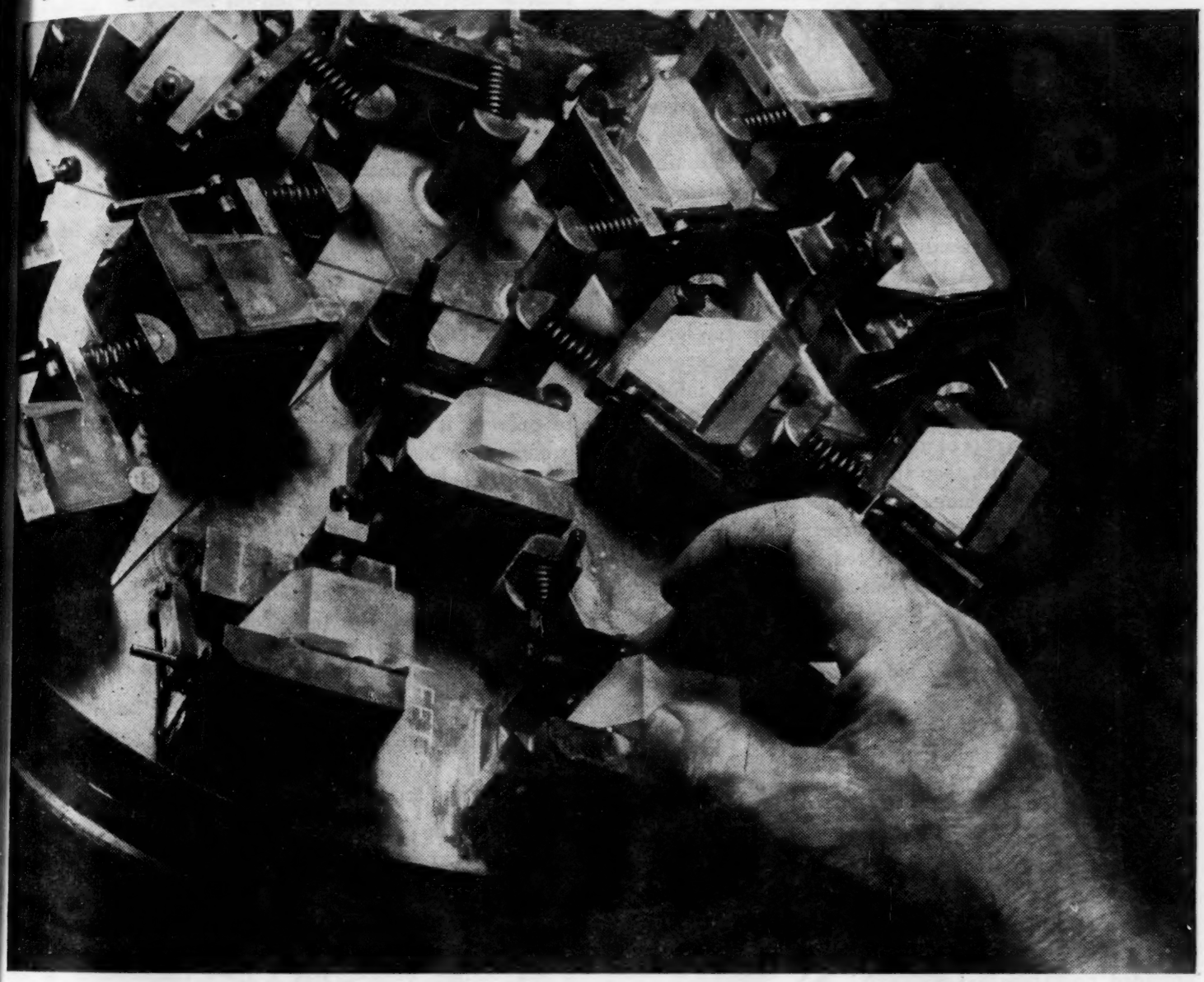

A Diamond *and* the Rough

Optical lenses and prisms, formerly had to be separately and accurately mounted in pitch or plaster of Paris for rough and fine grinding and polishing. Today, more and more of these Bausch & Lomb optical elements are diamond milled before polishing. Optical parts are quickly and accurately set up in special precision jigs and speedily surfaced with diamonds on huge precision milling machines. Thus, today, Bausch & Lomb optical elements are fabricated with better control of dimensions . . . faster. Bausch & Lomb Optical Co., 642-5 St. Paul St., Rochester 2, N. Y.

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specific nature. To speak of them as 'determiners' is to make use of a convenient figure of speech; but this need imply no more than that they are differentials by the use of which we are enabled accurately to analyze the observed results'' (p. 1113). To take this concept to its logical conclusion has a radical effect upon biological theory, as the writer has shown in a series of papers on the causes of color patterns. It is preferable to use the term ''inhibitor'' rather than ''modifier,'' since the latter has a more restricted meaning in genetics, and extend to the whole of genetics the concept of inhibiting factors which is used to explain melanin pigment inhibition in animals. The concept of hereditary factors as inhibitors is not generally used by plant geneticists, though the evidence is in its favor. Thus, the chromosome-borne inhibitors in albino plants are quite obviously responsible for the inhibition of plastid development, which may be complete as in white plants, or incomplete inhibition as in yellow plants, with still less inhibition for red-colored plastids (chromoplasts). Since flower color is caused by sap pigments produced by plastids, or chromoplasts, or both, then the inhibiting factor hypothesis has only to be extended to include the selective inhibition of one or more of the three primary pigments produced by the plastids, namely, red, yellow, and blue, or incomplete inhibition of the plastids themselves, together with a time variable when the inhibitors become effective, to account for color patterns. In animals there is no evidence that chromosome-borne factors are responsible for melanin pigment synthesis but only its partial or complete inhibition, the variegated patterns being caused by the time when the inhibiting substances appear in early or fetal life. The evidence points to black color as being the uninhibited expression of melanin pigmentation, and hence the conventional multiple allelic series in rodents is each reduced by one, namely, normal black color. Thus, the agouti series in rabbits has only two members, agouti or wild-type, and black-and-tan, normal black color occurring in the absence of these inhibitors provided no others are present.

The inhibitors arise spontaneously, as evidenced by mutations, and range from the dominant, gross type to those of the modifying or regulatory class, the latter being responsible for the nongenetically fixable grades of white spotting and size. The breeding methods of inbreeding, outcrossing, and selection are used for the purpose of attempting to fix the desired types of inhibitors and purge the organism of unnecessary ones. Thus, inbreeding maize purges the plant of some inhibitors but renders others homozygous. The crossing of two inbred strains which are homozygous for a maximum number of different inhibitors will yield the most vigorous hybrids. If the inhibitors could be destroyed, especially selectively, the breeding methods would be simplified. Submitting organisms to X-rays merely increases the number of harmful inhibitors or produces lethal effects through chromosome breakages. However, the inhibiting substances produced by the inhibitors can be neutralized in many cases. An extreme example is seen in the use of plant hormones as herbicides which seem to neutralize cellular inhibiting substances to the extent that the plant grows itself out.

The implication of the inhibiting factor hypothesis is that growth is an inherent characteristic and the chromosome-borne factors merely inhibit metabolism in varying degrees. In other words, under optimum conditions of temperature, light, and nutrition and with a minimum of internal inhibitions caused by chromosome-borne inhibitors, together with an absence of toxic products of metabolism or the neutralization of such, cell growth would be at its maximum rate, and differentiation would not occur. This view has some support from tissue-culture experiments. It is also supported on evolutionary grounds. Thus, the first spontaneously originated compound to form organic matter must have had the constitutional characteristic for its own duplication and hence growth; it could not have acquired this characteristic as it could not have survived to do so. What would be necessary would be a breaking up of the organic mass to prevent it from becoming a victim of its own toxic products of metabolism. The spontaneous origin of inhibitors would provide the necessary mechanism, since inhibitors have the characteristic of repulsion after duplication, as is evident in mitosis and by inference also in single-celled organisms. Evidence that complex molecular entities duplicate themselves is seen, in addition to the chromosome-borne inhibitors, in plastids and virus molecules, all of which require the specific organization of the cell to do so.

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Are Scientists Irresponsibles?

The leading article, ''Can we curb the irresponsibles?,'' by Lawrence K. Frank (*Science*, 1946, 103, 349–351), deals with a most important matter on which clear thinking is eminently desirable, but after reading it three times, I find myself much confused. Perhaps I am unduly obtuse, but I need clarification of Dr. Frank's position.

I wholly agree that responsibility for aggression must be brought home to the guilty individuals and adequate punishment inflicted on them, and that the Nürnberg trial is, therefore, fully justified and is based on principles which must be maintained if we are to hope for lasting peace.

But Dr. Frank seems to proceed from this sound basis to the propositions that scientists, by working on atomic bombs are guilty of aggression and may be held liable to punishment, and that an association of scientists may be able by their own action to relegate the atomic bomb to extinction. I cannot follow him on either of these points.

Surely there is a clear distinction between contributing to our military power and using that power for aggression. The scientific work which produced the atomic bomb differed not in character but only in effectiveness from other scientific work which contributed to the development of faster fighting planes, more

erful bombers, air-borne radar for strategic bomb-, proximity fuses, and the innumerable other new pons of the most technological of wars. In that war, which we were the victims of aggression, it was the ious duty of every scientist to give our armed forces the help he could. Now that the war is ended, but peace not yet achieved, it remains the duty of ry good citizen, including the scientist, to do what needful to maintain our national strength in order t we may lead in the firm establishment of a strong ernational organization. Should our Government mis- that strength to start an aggressive war, the sci- ist, like all other citizens, no more and no less, uld share in the guilt if he acquiesced.

As for the second point, while we all earnestly hope t never again will an atomic bomb be dropped on man beings, the only insurance against it is the crea- n of an international organization strong enough to law the use by any nation of the atomic bomb and er weapons for mass slaughter, to enforce its law by equate policing, and to inflict individual punishment r infractions. No voluntary association of scientists n exercise such governmental powers. It seems to unfortunate to deflect attention from the only true medy by raising hopes in a measure which is certain prove inadequate.

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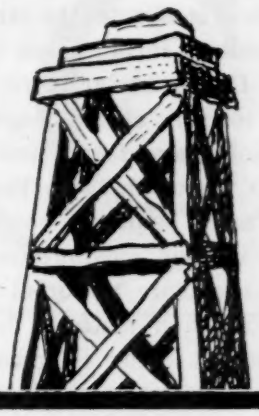
Book Reviews

Chemical crystallography: an introduction to optical and X-ray methods. C. W. Bunn. Oxford, Engl.: Clarendon Press, 1945. Pp. xii + 422. (Illustrated.) $7.50.

The author's purpose, as stated in the Preface, is to present a practical guide to optical and X-ray methods for the identification of solid substances and for the determination of atomic configurations in crystals. His treatment of the subjects is designed primarily to introduce the chemist to these techniques and to provide him with a sufficient background to enable him to begin to apply the principles. In accomplishing his purpose, the author has been highly successful. The success is due, in great measure, to the simplicity of the presentation. Mathematics, for instance, has been kept to a minimum consistent with a thorough understanding of the practical applications of crystallography.

The subject matter is divided into two sections. The first, dealing with identification, is concerned with the use of morphological characteristics, indices of refraction, and X-ray powder patterns in chemical analysis. Elementary crystal theory, including symmetry, nomenclature of planes, growth features, etc., is clearly presented. The meaning of the refractive indices and their measurement and use in identification are particularly well developed.



The boisterous saga of America's oil pioneers . . . capturing the restless, enterprising spirit of the great figures of wildcatting — from Williams, Drake, and Galey to Joiner and Gutowsky— and the excitement of life in the oil boom towns. A lively, informal history by a veteran operator and scout.

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Illustrated with photographs.

The second section is devoted to structure determination and is an excellent introduction to both its theory and applications. Of particular merit is the use of the reciprocal lattice concept at the beginning of the development of single crystal techniques rather than in a later section, as is customary. In the reviewer's opinion, considerably more emphasis could profitably have been put on the various moving-film methods. These techniques, which are more powerful and easier to interpret than the rotation method, deserve a full discussion for the student being introduced to X-ray diffraction.

In regard to the physical make-up of the book, the author is to be commended for the general excellence of the line drawings, most of which were made especially for the purpose. The inclusion of a section of selected references for the various topics covered would have been an improvement, since no introductory volume can be expected to cover all phases of the subject thoroughly and additional reading is necessary.

On the whole, the present volume is a very worthwhile contribution. It should find widespread use as a text in the study of structural crystallography.

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Principles of dynamic psychiatry: including an integrative approach to abnormal and clinical psychology. Jules H. Masserman. Philadelphia: W. B. Saunders, 1946. Pp. xix + 322. (Illustrated.) $4.00.

In the author's own words the purpose of his book is "to provide an orientative introduction to the principles of modern dynamic psychiatry, to outline their application to the techniques of clinical diagnoses, and to demonstrate the rationale and methods of effective therapy." All this in a little over 200 pages of text! Admittedly, Dr. Masserman has set himself a difficult task. If he does not wholly accomplish it, it will surprise no one who possesses any familiarity with this field. Actually, he has made an excellent approximation to his goal, even if he has not quite hit the bull's-eye.

The book is so condensed, so concentrated, that one doubts whether it could possibly convey much meaning to the uninitiated, to the uninstructed reader, however zealous his ardor for learning. Added to this, the author's liking for twenty-five-dollar words (such as "frustraneous," "semeiotic," "circumambient milieu," "temporal desuetude," "identificatory," and "neurogenetic dynamisms") is such that the result is a turgidity and stickiness of style which makes reading sometimes difficult. One gets the feeling of having eaten a meal of K-rations covered with blackstrap molasses. It is very much to be hoped that before the companion text, *Practice of dynamic psychiatry,* appears Dr. Masserman will take his blue pencil firmly in hand and apply it vigorously to all such cant phraseology. If he does, the volume will be a useful addition to expository literature. For there can be no doubt whatever that Dr. Masserman knows his subject. His brilliantly chosen and succinctly put case histories are in themselves evidence of this.

He has, moreover, a mature discrimination and a philosophically holistic point of view which will commend itself to the sophisticated student and is rarely found in an experimentally gifted specialist.

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Basic electrical engineering: circuits, machines, electronics. A. E. Fitzgerald. New York and London: McGraw-Hill, 1945. Pp. ix + 443. $3.75.

Planning an electrical engineering course for students majoring in other subjects becomes an ever more difficult task, because the number of topics that might be treated increases with technological progress, while the time allowed for the course usually decreases. Obviously there comes a time when more and more subject matter cannot be crammed in, and it becomes necessary to re-evaluate the field, select only that material which is of current or likely future importance, and organize it into a new whole. This is what the author has attempted in *Basic electrical engineering,* with what appears to be a high degree of success.

The treatment is directed toward the user of electrical engineering apparatus and is by no means a condensation of a complete major course in electrical engineering, as is unfortunately the case with many texts in this field. Emphasis is on external characteristics with only such discussion of the inner workings as is necessary to an intelligent understanding of the equipment. Consistent with modern electrical engineering technology, the treatment of direct-current equipment is subordinated to that of alternating current. Motors are emphasized in comparison with generators, as is appropriate in a text directed to potential users of electrical tools. It is noteworthy that fully one-third of the text is devoted to electronic circuits and equipment.

In style the book is very readable. The theoretical developments are simple and direct, and where there are departures from generality or complete rigor for the sake of brevity some note of this is usually made. Free use is made of electrical engineering short cuts, such as equivalent circuits, vector diagrams, and complex notation. While these are explained adequately, students not proficient in mathematics might have difficulty in grasping the ideas in some cases. There are illustrative examples throughout the book and a fine collection of problems at the end of each chapter.

The book is well designed; diagrams are clear and properly labeled; and there is an appropriate selection of illustrations suitably placed in relation to the text. Typographical errors exist in no more than normal numbers.

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